

**MAP BASED COMPARISON OF POPULATION IN MAJOR CITIES OF
UNITED STATES OF AMERICA**

A Thesis

Presented to the

Faculty of

San Diego State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

in

Computer Science

by

Suman Krishna Saripally

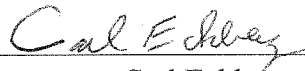
Fall 2010

SAN DIEGO STATE UNIVERSITY

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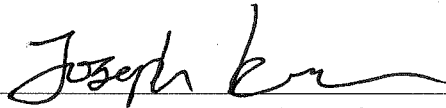
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Map Based Comparison of Population in Major Cities of United States of
America



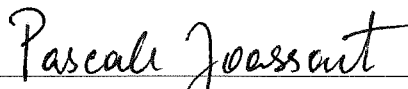
Carl Eckberg, Chair

Department of Computer Science



Joseph Lewis

Department of Computer Science



Pascale Joassart

Department of Geography



Approval Date

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DEDICATION

To my father Srinivasa Reddy, my mother Radha, my brother Sandeep, family, roommates Prasad, Siva, Siva Bhaiyya, Koti, Rajiv, Santosh, Abhishek, Rakesh and friends who have always given me endless support and love.

ABSTRACT OF THE THESIS

Map Based Comparison of Population in Major Cities of United
States of America

by

Suman Krishna Saripally
Master of Science in Computer Science
San Diego State University, 2010

Rising population has been one of the biggest challenges over few decades, and it has been affecting almost everything from the tillable land, rain forests, and metallic ores to the current job situation, the crime rate and the current economy. There are various reasons for population growth like lack of birth control and cultural traditions in less developed countries, increased longevity and medical advances in developed countries to name a few.

We need to talk about this (population growth) serious challenge to the younger generation and make them aware of what is going on around them and start educating them so that when they grow up they don't end up making the mistakes their elders have done. We don't want a day when we have to go the museum to see a piece of coal or pictures of forests.

My thesis focuses on the above topic of population growth but locally on some of the major cities in the United States of America and more locally on the county of San Diego's crime rate which is one of the effects of population growth. It has been developed as a teaching aid for one of the geography teachers at Helix Charter High School who can also do some analysis on San Diego using the tool apart from just population and crime rate information.

Data and numbers might not make much sense when shown just on a piece of paper or a text file, instead if it is put into some kind of pictorial form it would definitely grab more attention. Technology has advanced so much in the past few decades and there are so many tools out there which can process the output to produce a nice pictorial representation of the data which has been fed. Students can be kept interested in the topic by showing the changes in the population via a graph or a picture and the teacher can talk about the factors influencing the changes in the population.

GIS (Geographic Information System) has been on the rise for the last two decades and is a mixture of geography and computer technology. It has been used to make web maps interactive and interesting. GIS allows us to analyze, understand, and visualize data in many ways. Most GIS software available is expensive and many schools don't feel like spending much or might not have funds. The teacher and the students will get their hands on a product or tool which is state of the art.

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I thank God for giving me the opportunity to go to San Diego State and for everything which he has given me.

CHAPTER 1

INTRODUCTION

There have been various methods of teaching and transferring knowledge over centuries, of which teaching by showing a picture or an example of a real object has proved to be a very effective way. Remember how you were taught alphabets when you were a kid by showing the pictures next to letters on charts, books and so on. Students could easily relate the topic to the pictures already imprinted in their heads while they were being taught which in turn is good for them on their tests and in real life application as well.

The purpose of this thesis is to provide an interactive state of the art tool to students and teachers, who can use it to analyze their surroundings or locality while learning about the population. GIS (Geographic Information Systems), which is a perfect blend of geography and computer technology, allows us to view, understand, question, interpret and visualize data in many ways which reveal relationships, patterns, and trends in the form of maps, reports and charts [29] (see Appendix A for a list of acronyms).

This tool has been developed in NetBeans IDE (Integrated Development Environment) [14] using the powerful yet simple features of Map Objects API (Application Programming Interface) [12] in the Java programming language. The thesis has been developed as a customized teaching aid to Mr. Sean Morris who is one of the geography teachers at Helix Charter High School, La Mesa, California. He now can teach population changes in major cities of United State of America very effectively by showing the patterns in population charts on the interactive web based map. Moreover he can easily add or remove cities over time, a feature not available with textbooks, introduction to the thesis is given in chapter one. Rise in population is a serious issue; chapter two talks about the issue and also about the cities selected within the United States of America; chapter three talks about the technologies used for the development of the thesis. Requirements for the development are covered in chapter four, while the data preparation for the United States of America base map, longitude and latitude values of the major cities in a CSV (Comma Separated Values) file is covered in chapter five. Population and crime data were collected for the major cities

in the United States of America and San Diego County, and is discussed in chapter six. The process of configuring Map Objects in NetBeans IDE is discussed in chapter seven. Chapter eight discusses how the application was developed. The thesis is concluded in chapter nine, and chapter ten has some future work ideas.

CHAPTER 2

RISE IN THE POPULATION IS A SERIOUS ISSUE

Rising population has been a large challenge over the last century, and it has been affecting almost everything from the tillable land, rain forests, and metallic ores to the current job situation, the crime rate and the current economy. Today the current world population is expected to be 6.6 billion and is expected to be 9 billion by the year 2050 [30]. There are various reasons for population growth like lack of birth control and cultural traditions in less developed countries, increased longevity and medical advances in developed countries to name a few.

Although total world population is growing, Russia and other European countries are facing steep declines in population. Some reasons for population decrease in Russia and other places are drugs, alcoholism, sexually transmitted diseases, education, birth control, and safe abortion. It is believed that 15% of Russian couples are infertile and about 75% of women experience serious medical problems during pregnancy [3]. Along with the above reasons, declining births and life expectancy are also adding to the serious decline in the population. Table 2.1 shows world historical and predicted populations (in millions) [30].

Table 2.1. World Historical and Predicted Populations (in millions)

Region	1500	1600	1700	1750	1800	1850	1900	1950	1999	2008	2050
World	458	580	682	791	978	1262	1650	2521	5978	6707	8909
Africa	86	114	106	106	107	111	133	221	767	973	1766
Asia	243	339	436	502	635	809	947	1402	3634	4054	5268
Europe	84	111	125	163	203	276	408	547	729	732	628
Latin American and Caribbean	39	10	10	16	24	38	74	167	511	577	809
Northern America	3	3	2	2	7	26	82	172	307	337	392
Oceania	3	3	3	2	2	2	6	13	30	34	46

As world population is a very broad topic, some major cities in the United States of America have been selected for detailed discussion. Table 2.2 lists the major cities selected.

Table 2.2. Major Cities in the United States of America

REGION	CITY
West Coast	San Diego
	Los Angeles
	San Francisco
	Seattle
South West	Dallas
	Phoenix
	Denver
Mid-West	Chicago
	St. Louis
	Bismarck
South	New Orleans
	Birmingham
	Atlanta
North East	New York City
	Philadelphia
	Detroit

From the above listed cities there are a few cities whose population has certainly changed over the last few years, namely San Diego, Los Angeles, Dallas, Detroit, and Bismarck. Cities like San Diego, Los Angeles and Dallas which are closer to the border have seen the rise in population over the years due to illegal immigration. There were like 11 million illegal immigrants in the United States in the year 2008 according to the Center for Immigration Studies [13], of which 56% were from Mexico. Looking at the numbers we can apply the same population rise theory to these three cities which share the border with the other country.

As population increased over time, cities have expanded their boundaries to accommodate the rise. It would have been more accurate if we could normalize the population growth by area, but that data would be hard to get. Most of the population data

used in this thesis has been collected from the internet which mostly is the census data published by the United States Census Bureau.

Bismarck is North Dakota's capital and the situation is similar in Bismarck, as it is in North Dakota. The state has seen a constant decline in the population, especially among the younger generation with college and university degrees. Lack of skilled jobs for graduates and bad weather are some of the reasons for the decline in the population in North Dakota.

When the world economy tumbled recently, people started being watchful on their spending and started using alternative ways to go out, other than using their vehicles. Detroit was a symbol of a dynamic United States economy [23] and was the home for many auto makers. After the economy went down, people started losing jobs as auto production was not that great. And the city which is known for putting the United States on wheels had nothing much to offer when the auto production was slow but to cut jobs, and as a result the city has seen serious emigration.

When we talk about each city, we try to identify issues which influenced the population of the city. By showing the data to the students on graphs using this tool, Mr. Morris can pass on more information, more effectively.

CHAPTER 3

TECHNOLOGIES USED

3.1 JAVA

Java has been selected for developing this tool for the following features:

1. Java is "simple, object oriented and familiar". The whole thesis is divided and developed as classes which can be instantiated using objects. Mr. Morris asked for a few changes once the thesis was almost ready, and since it was divided into classes it was easy to make the changes very effectively and quickly.
2. Java is "Platform Independent". This tool is developed for Mr. Morris, but can also be used by other teachers at Helix Charter High School. The tool has to run on different platforms as you never know which teacher uses which platform/operating systems. As Java is platform independent, the tool can be run on almost all the platforms, and at many schools besides Helix.
3. Availability of Map Objects Java Edition". Map Objects Java Edition has lots of features which are fairly easy to learn and are also easy to implement [12].
4. Open Source: Java can be downloaded for free from the internet and so a good development environment. As this thesis will be used as a teaching aid, students might come up with better ideas, and future enhancements can be done easily without worrying about spending money on the software and the environment (checking the version of Java is discussed in Appendix B).

3.2 MAP OBJECTS JAVA EDITION

Map Objects Java Edition is a set of API classes, which when combined with Java gives lots of features to the developer. Its features are powerful and yet are easy to implement to create web-based map applications. It has a small footprint and allows almost arbitrary customization. And by being Java based it is easily deployed. For these reasons it was a good choice for the GIS technology for this thesis.

Following are some of the features of Map Objects Java Edition:

1. Both desktop and web-based map applications can be created using it.
2. Applications creating using Map Objects can be run on any machines irrespective of the platform [12].
3. It allows users to easily navigate through maps [22].
4. Ad-hoc queries can be run on spatial data and can also perform geometric operations.

5. It allows easy customization of maps [12].
6. Multiple data sources can be accessed using Map Objects [22].
7. Map Objects Java Edition API can be easily integrated into NetBeans IDE, which is the environment used for this thesis development. Development, testing and deployment can be done easily in the NetBeans IDE [12].

CHAPTER 4

REQUIREMENTS

This thesis is a teaching aid tool for Mr. Morris, one of the teachers in the Social Studies Department at Helix Charter High School. Mr. Morris has been the primary contributor for this thesis and the thesis has been customized as per his needs. Dr. Carl Eckberg has been the driving force behind the idea of using GIS technology for the development of this tool [11].

Listed are the requirements for my thesis:

1. Map Objects Java edition should be used for tools' development.
2. Tool should be visually appealing as the whole idea behind the development is to attract students and provide them valuable information.
3. Customized base map of the United States of America should be displayed when the tool is opened.
4. Instructions should be provided under the help section within the tool, so that students can use the tool effectively without any difficulty.
5. User should be able to input the data as a CSV (Comma Separated Values) format file.
6. The tool can be adapted by a teacher for any set of input files as long the file has data in the correct format.
7. Based on the data in input files points (cities) should be plotted on the base map.
8. Once cities are plotted, users should be able to label them, change their shape, color so on and so forth.
9. Users should be able to see the position of the cursor and also the distance between the cities.
10. Upon clicking on a certain city, a population chart for that particular city should pop-up.
11. Users should be able to click a button on the pop-up for a city and be able to see the particular city's details on Wikipedia.
12. Users should be able to add different shapefiles and should be able to perform some analysis.
13. Users should have the capability of saving the analysis result as a different shapefile.
14. The tool should run on multiple platforms.

CHAPTER 5

DATA PREPARATION

The base map used for this tool has been customized as per the requirements. As the main concentration is on the major cities of the United States of America, Alaska and Hawaii have been removed from the map.

The shapefile (one of the GIS file formats) for the United States of America has been taken from the ‘Samples’ folder within the Map Objects installation folder [28]. Below are the steps followed to get the customized base map from the original map:

1. Use ArcMap, which is one of the programs in ArcGIS Desktop software (acquired from Dr. Piotr Jankowski, Dept. of Geography, San Diego State University) to open the original map for editing. Figure 5.1 shows it.
2. Next, Alaska and Hawaii have to be removed from the map. To do so:
 - a. From the toolbar select the “Editor” tool and click “Start Editing”, as shown in Figure 5.2.
 - b. When the tool is active and ready, hold the “Shift” key on the keyboard and click on Alaska and Hawaii on the map. Now you can see that both Alaska and Hawaii are selected, shown in Figure 5.3.
 - c. With Alaska and Hawaii selected, hit “Delete” key on the keyboard to delete them from the map. Figure 5.4 shows the map after the deletion.
 - d. Now from the toolbar select the “Editor” tool again and click “Stop Editing”, as shown in Figure 5.5.
 - e. Click “Yes” when asked for saving the edits, Figure 5.6 shows the save dialog.

Now that we have the required custom base map, we need to create CSV (Comma Separated Values) files for the major cities of the United States of America and San Diego county cities; these files will be the input files for the tool which will in turn convert them to point shapefiles.

Information such as latitude and longitude from “<http://maps.google.com>” was used to create the CSV file for the major cities of the United States of America. Figure 5.7 shows the screenshot of the file.

Similarly the CSV file for San Diego county cities has been created using the information from <http://maps.google.com>; Figure 5.8 shows the screenshot of the file.

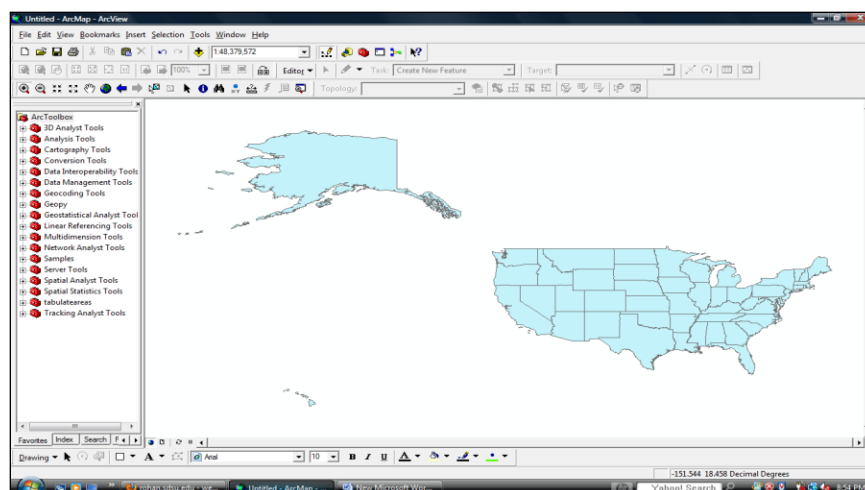


Figure 5.1. Original map of the United States of America.

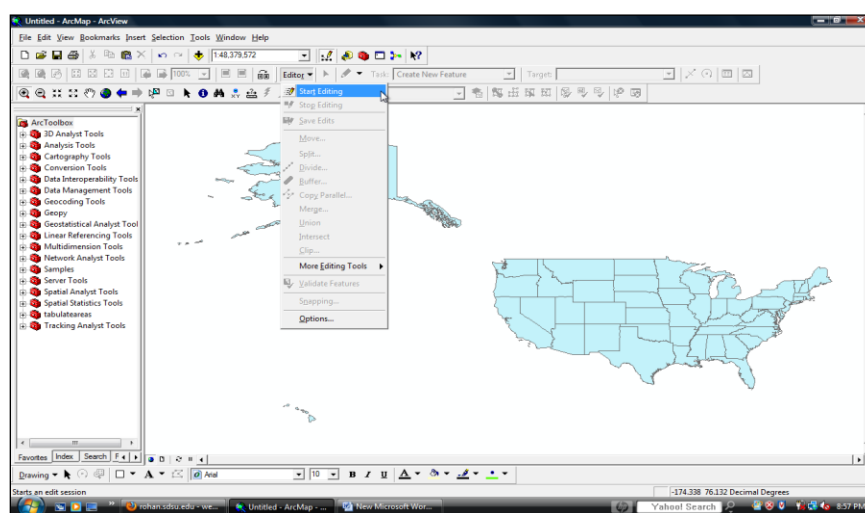


Figure 5.2. Selecting “Editor” tool to start editing.

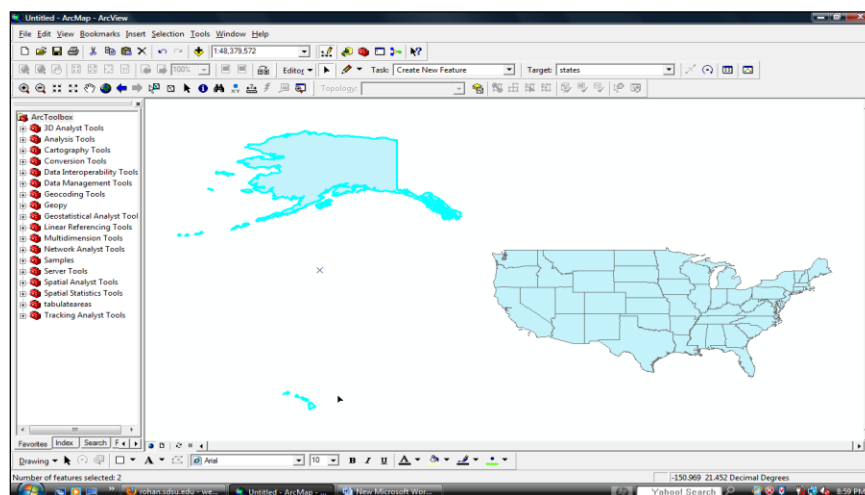


Figure 5.3. Alaska and Hawaii are selected.

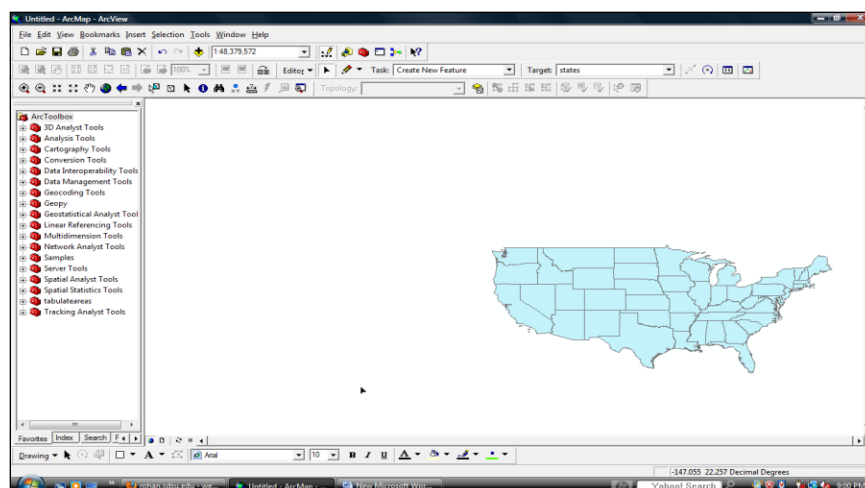


Figure 5.4. Original map after deleting Alaska and Hawaii.

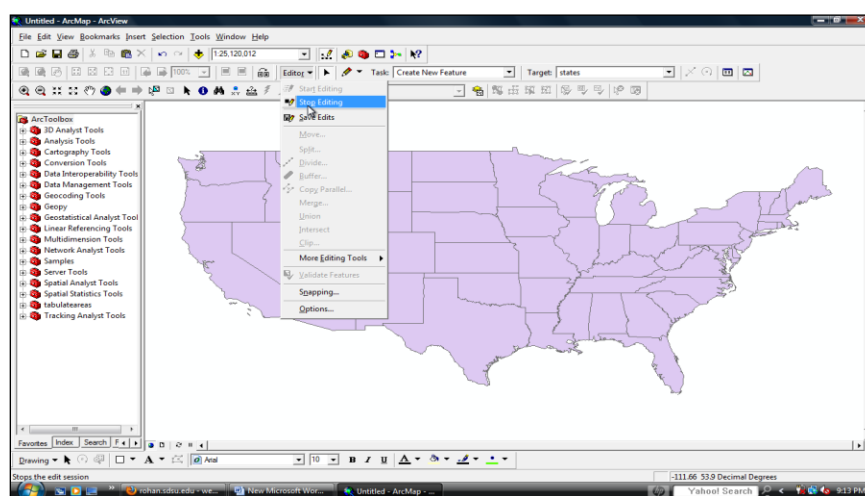


Figure 5.5. Selecting "Editor" tool again to stop editing.

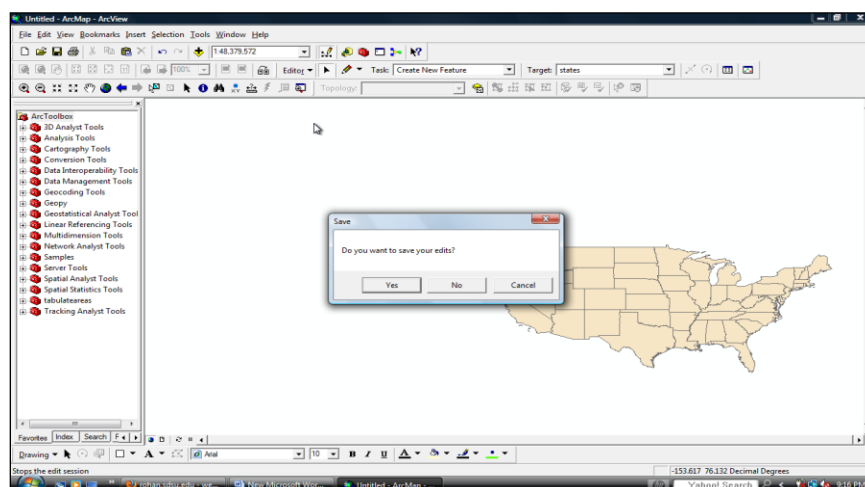


Figure 5.6. Dialog for saving the edits.

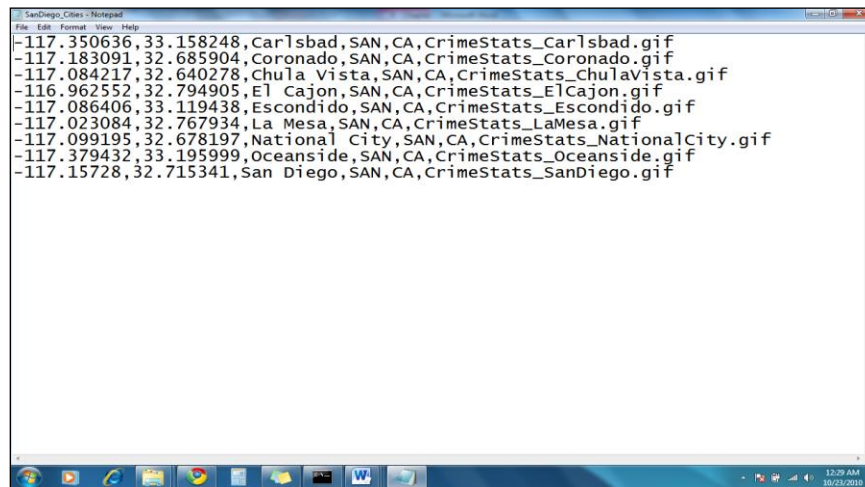


```

-86.800461,33.548605,Birmingham,AL,BHM,caw.jpg
-84.388161,33.759341,Atlanta,GA,ATL,ATL_Chart.gif
-90.074616,29.988958,New Orleans,LA,NEW,NO_Chart.gif
-112.071991,33.496285,Phoenix,AZ,PHX,PHX_Chart.gif
-96.770554,32.816479,Dallas,TX,DAL,DAL_Chart.gif
-104.984207,39.747639,Denver,CO,DEN,DEN_Chart.gif
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-122.419395,37.780104,San Francisco,CA,SFO,SFO.gif
-118.243561,34.080645,Los Angeles,CA,LAX,LA_Chart.gif
-122.332993,47.615699,Seattle,WA,SEA,SEA_Chart.gif
-87.650528,41.862709,Chicago,IL,CHI,CHI_Chart.gif
-100.782509,46.8096,Bismarck,ND,BIS,Bismarck_Chart.gif
-90.221214,38.651359,St Louis,MO,STL,STL_Chart.gif
-83.04451,42.335504,Detroit,MI,DET,DET_Chart.gif
-74.00568,40.715075,New York,NY,NYC,NYC_Chart.gif
-75.163679,39.95282,Philadelphia,PA,PHL,PHI_Chart.gif

```

Figure 5.7. Screenshot of major US cities CSV file.



```

-117.350636,33.158248,Carlsbad,SAN,CA,CrimeStats_Carlsbad.gif
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-117.379432,33.195999,Oceanside,SAN,CA,CrimeStats_Oceanside.gif
-117.15728,32.715341,San Diego,SAN,CA,CrimeStats_SanDiego.gif

```

Figure 5.8. Screenshot of San Diego County cities CSV file.

CHAPTER 6

DATA COLLECTION

Population data for the major cities of the United States of America has been collected from various sources available on the internet. After collecting the data for each of the cities, it has been put together in the form of a bar chart using Microsoft Excel. Bar charts make more sense to the students as they can visually see what the numbers actually mean.

Microsoft Excel which is one of the programs in Microsoft Office suite has been used to create the bar charts. Table 6.1 [2, 4, 5, 6, 8, 9, 10, 15, 17, 18, 19, 20, 24, 25, 26, 27] shows the various links from which the population data has been collected.

Figures 6.1 to 6.16 are the bar graphs for the population data collected.

Table 6.1. Population Data URL's

REGION	CITY	URL USED
West Coast	San Diego	http://en.wikipedia.org/wiki/San_Diego
	Los Angeles	http://en.wikipedia.org/wiki/Los_Angeles
	San Francisco	http://www.sfgenealogy.com/sf/history/hgpop.htm
	Seattle	http://en.wikipedia.org/wiki/Seattle
South West	Dallas	http://en.wikipedia.org/wiki/Dallas
	Phoenix	http://en.wikipedia.org/wiki/Denver
	Denver	http://en.wikipedia.org/wiki/Phoenix,_Arizona
Mid-West	Chicago	http://en.wikipedia.org/wiki/Chicago
	St. Louis	http://en.wikipedia.org/wiki/St._Louis,_Missouri
	Bismarck	http://en.wikipedia.org/wiki/Bismarck,_North_Dakota
South	New Orleans	http://en.wikipedia.org/wiki/New_Orleans
	Birmingham	http://en.wikipedia.org/wiki/Birmingham,_Alabama
	Atlanta	http://en.wikipedia.org/wiki/Atlanta
North East	New York City	http://en.wikipedia.org/wiki/New_York_City
	Philadelphia	http://en.wikipedia.org/wiki/Philadelphia
	Detroit	http://en.wikipedia.org/wiki/Detroit

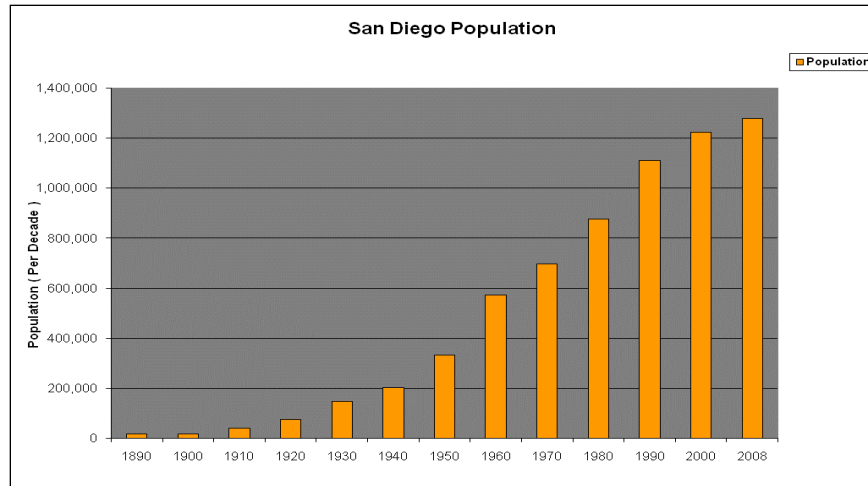


Figure 6.1. San Diego's population bar chart.

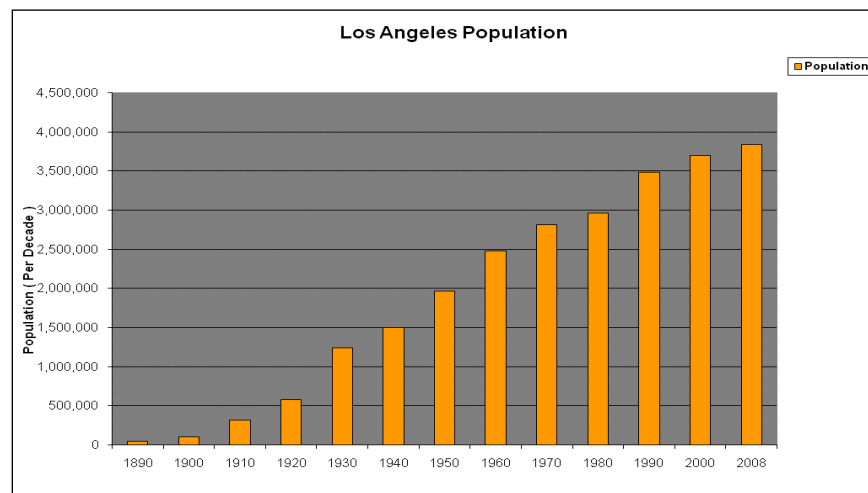


Figure 6.2. Los Angeles's population bar chart.

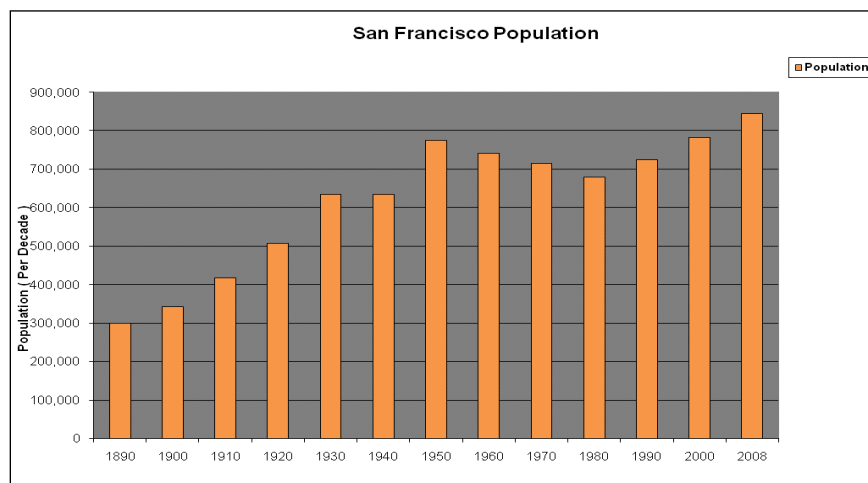


Figure 6.3. San Francisco's population bar chart.

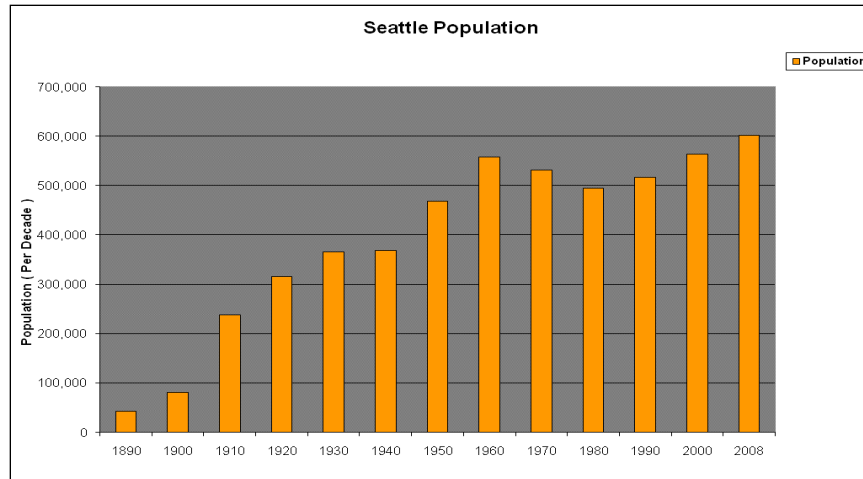


Figure 6.4. Seattle's population bar chart.

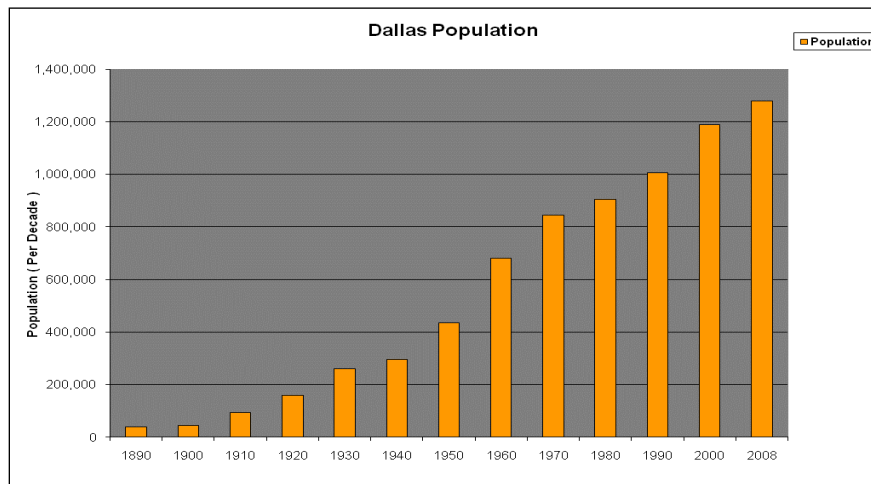


Figure 6.5. Dallas's population bar chart.

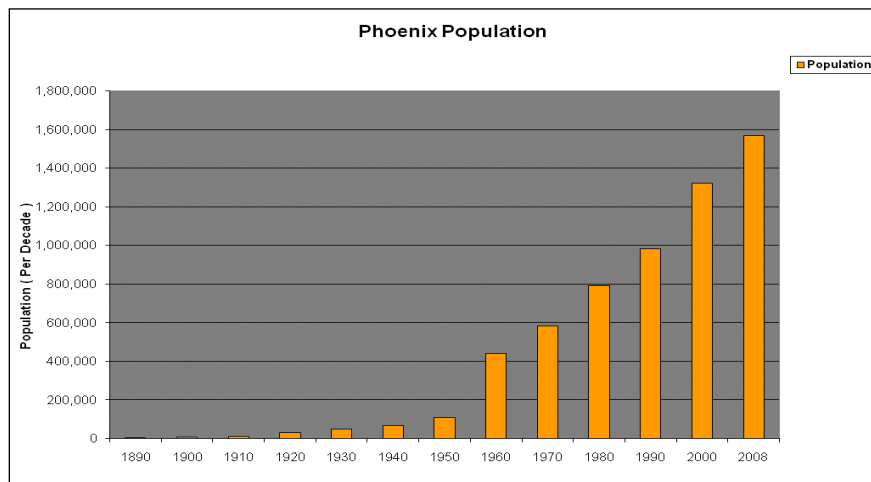


Figure 6.6. Phoenix's population bar chart.

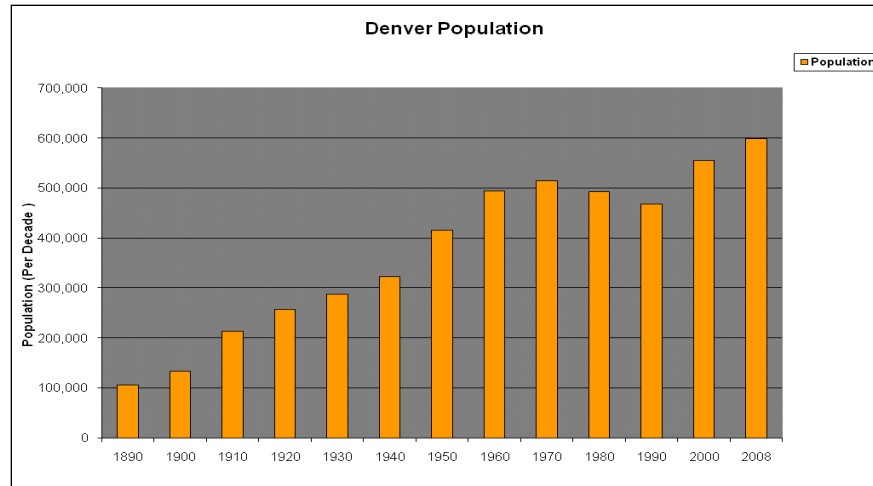


Figure 6.7. Denver's population bar chart.

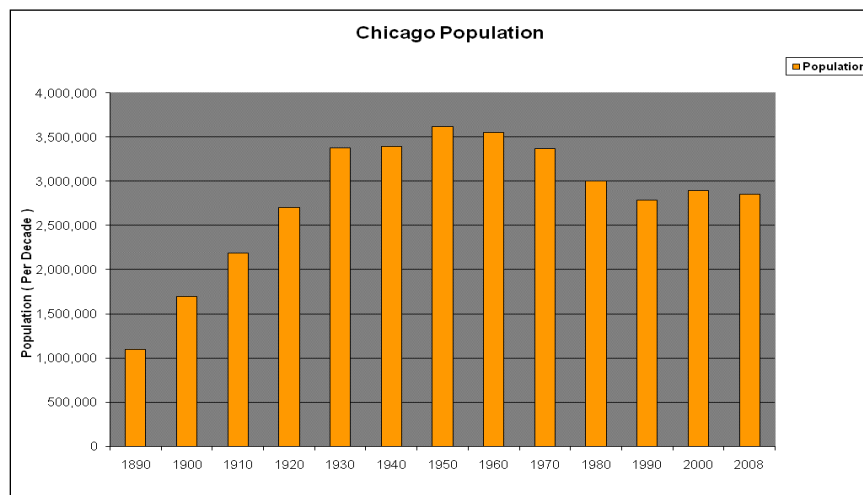


Figure 6.8. Chicago's population bar chart.

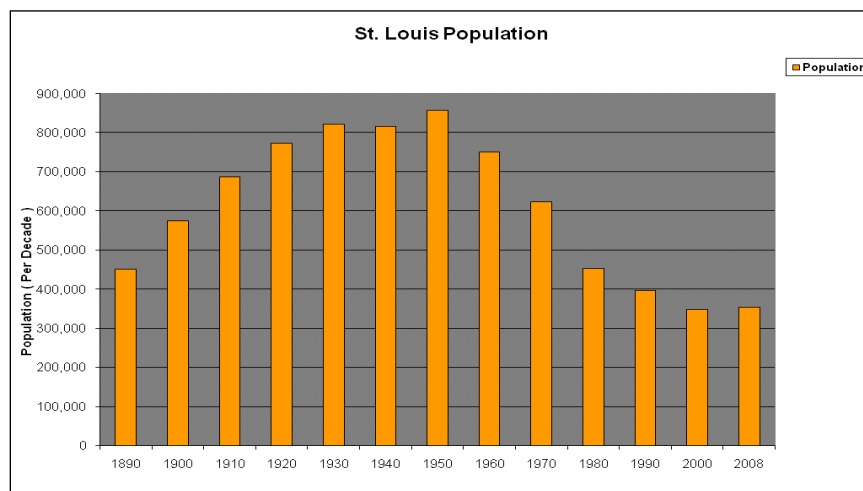


Figure 6.9. St. Louis's population bar chart.

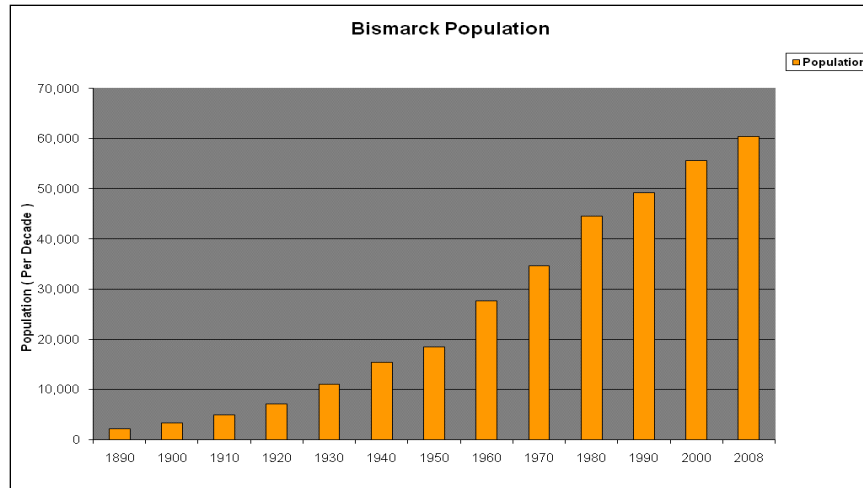


Figure 6.10. Bismarck's population bar chart.

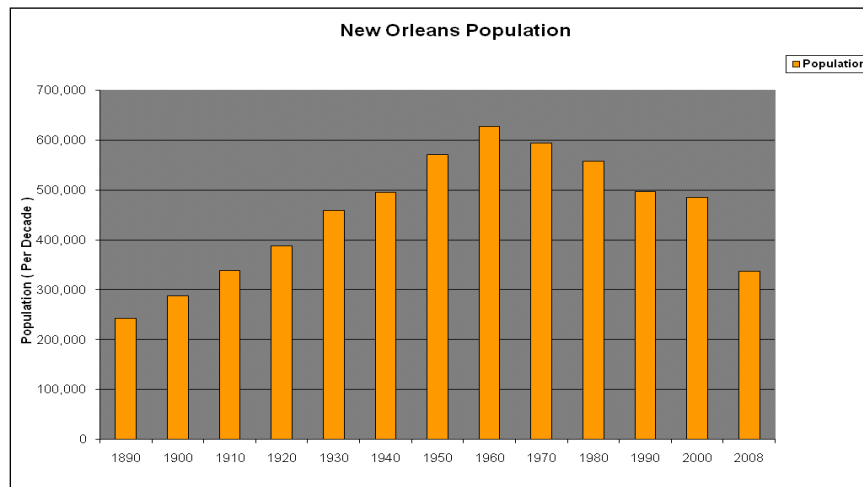


Figure 6.11. New Orleans's population bar chart.

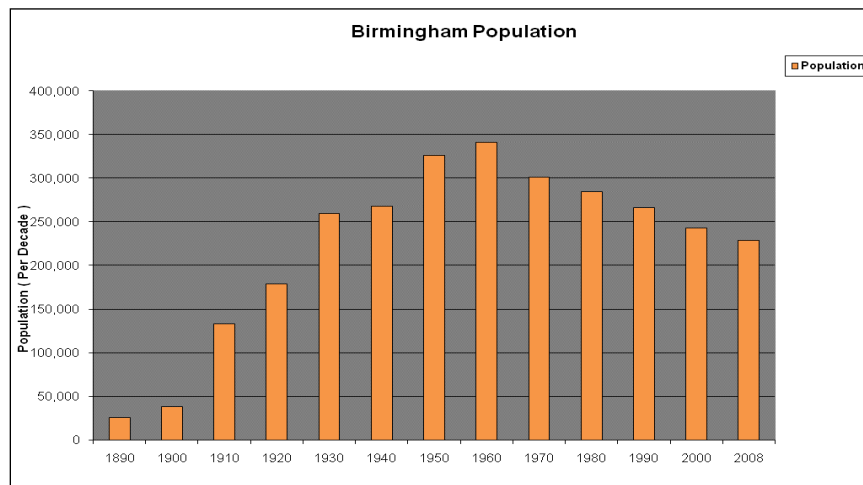


Figure 6.12. Birmingham's population bar chart.

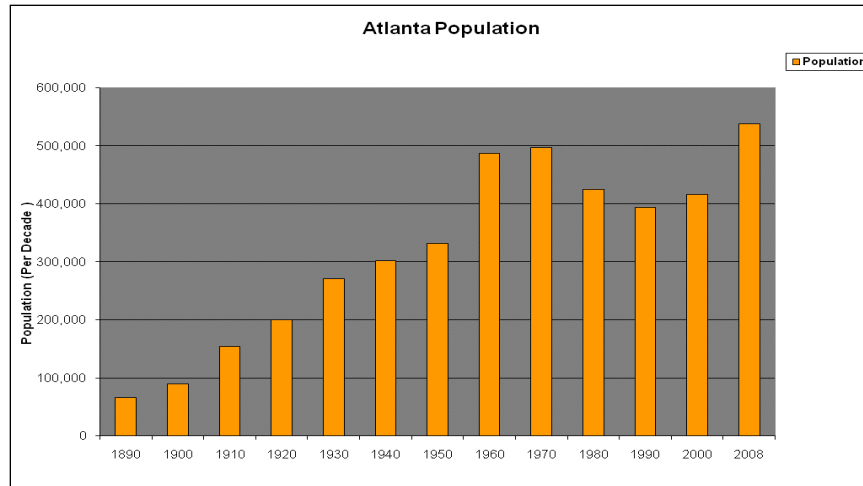


Figure 6.13. Atlanta's population bar chart.

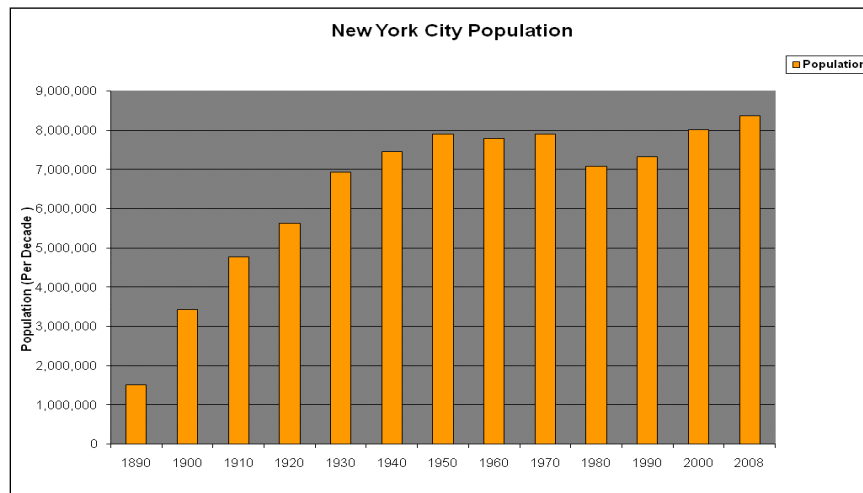


Figure 6.14. New York City's population bar chart.

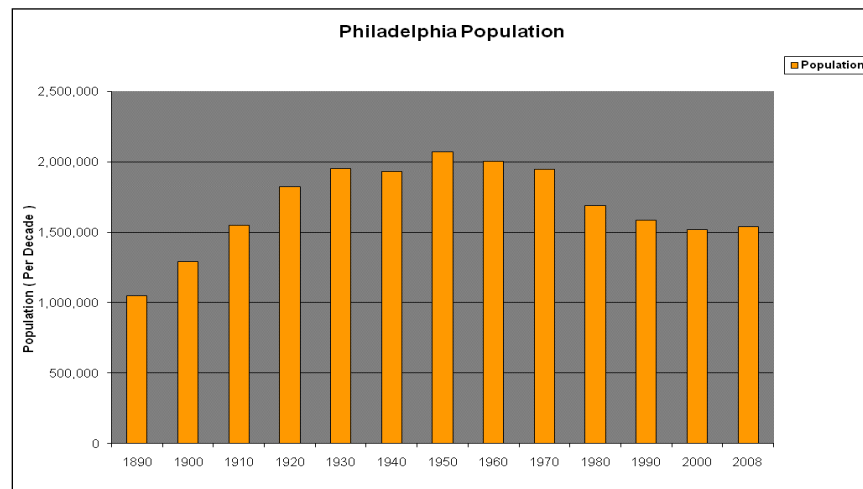


Figure 6.15. Philadelphia's population bar chart.

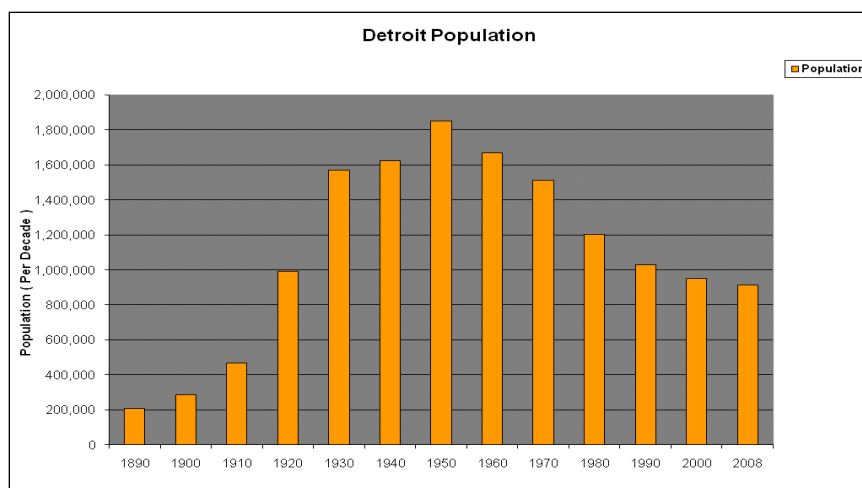


Figure 6.16. Detroit's population bar chart.

San Diego County's law enforcement agencies including the police department publish their crime statistics on the ARJIS (Automated Regional Justice Information System) website, which in turn is a division of SANDAG (San Diego Association of Governments) [1].

Crime data can be downloaded from the ARJIS website by clicking on "Crime Statistics" from the menu. The data can either be downloaded or printed and also you have options to enter begin and end date to get data within those dates. Data goes 2 years prior from the current year and current month, so you can only get the data for years 2008, 2009 and 2010.

Again Microsoft Excel program has been used to create the bar charts from the downloaded crime data. Below are the links for San Diego Police Department's crime statistics page and ARJIS:

- **San Diego Police Department Crime Stats.** <http://www.sandiego.gov/police/stats/index.shtml> [21].
- **ARJIS.** <http://www.arjis.org/> [1].
- **Crime Stats on ARJIS.** <http://crimestats.arjis.org/> [7].

Figures 6.17 to 6.25 are the crime data bar graphs for cities of San Diego County.

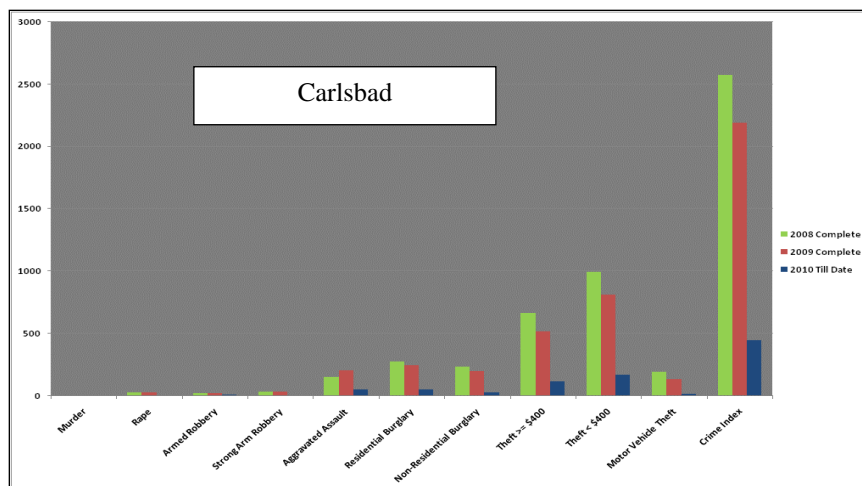


Figure 6.17. Carlsbad crime rate bar chart.

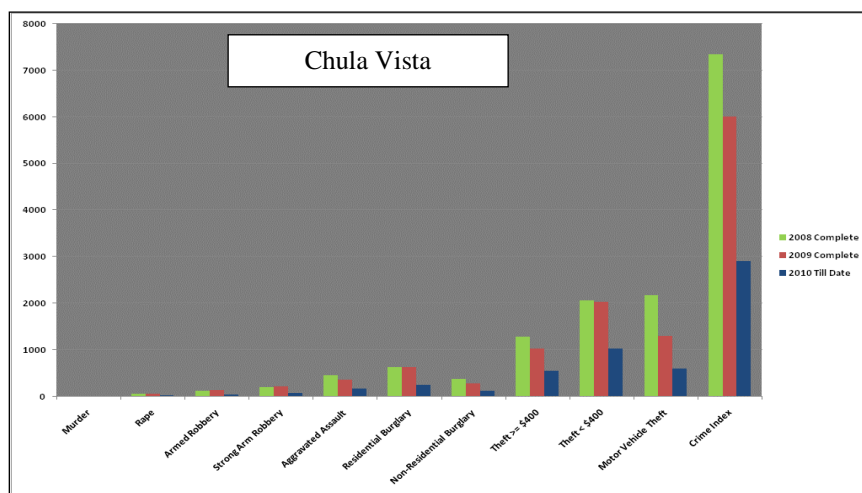


Figure 6.18. Chula Vista crime rate bar chart.

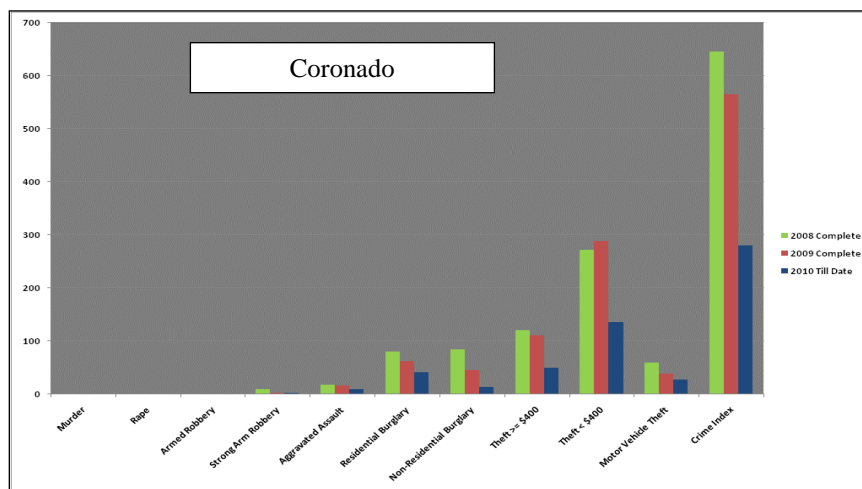


Figure 6.19. Coronado crime rate bar chart.

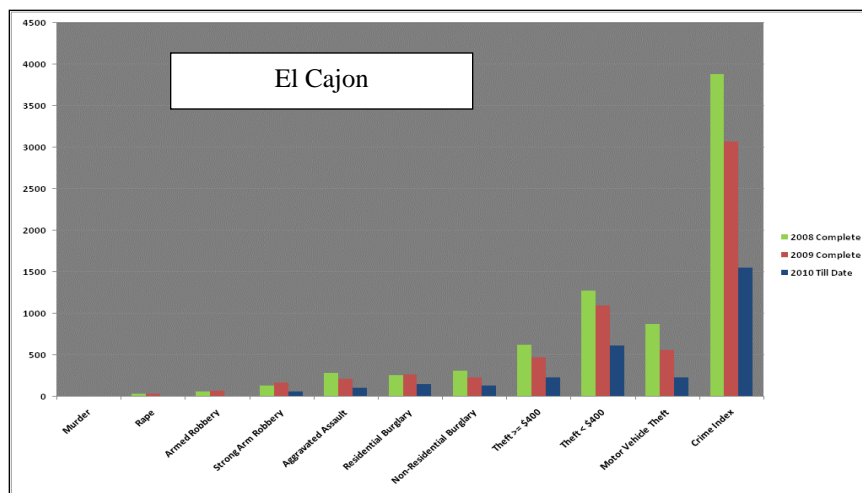


Figure 6.20. El Cajon crime rate bar chart.

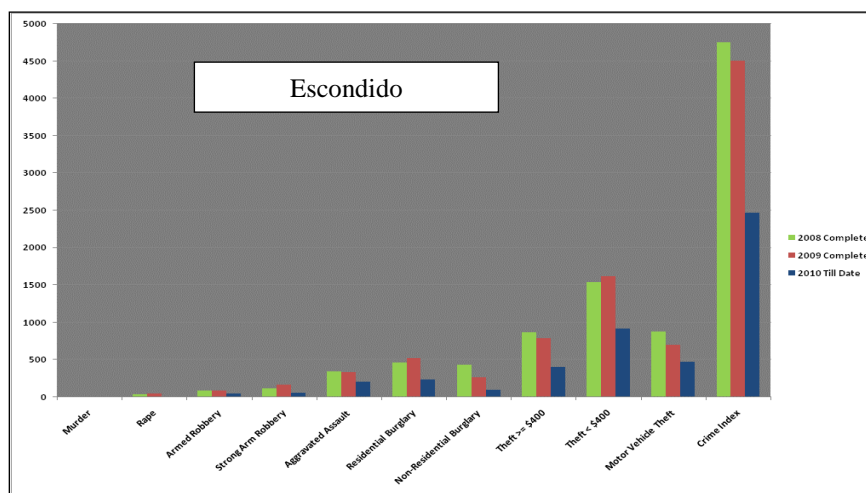


Figure 6.21. Escondido crime rate bar chart.

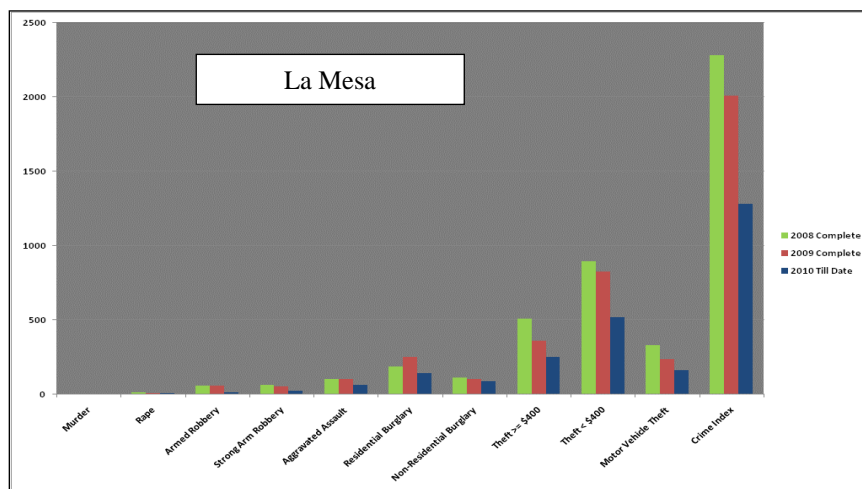


Figure 6.22. La Mesa crime rate bar chart.

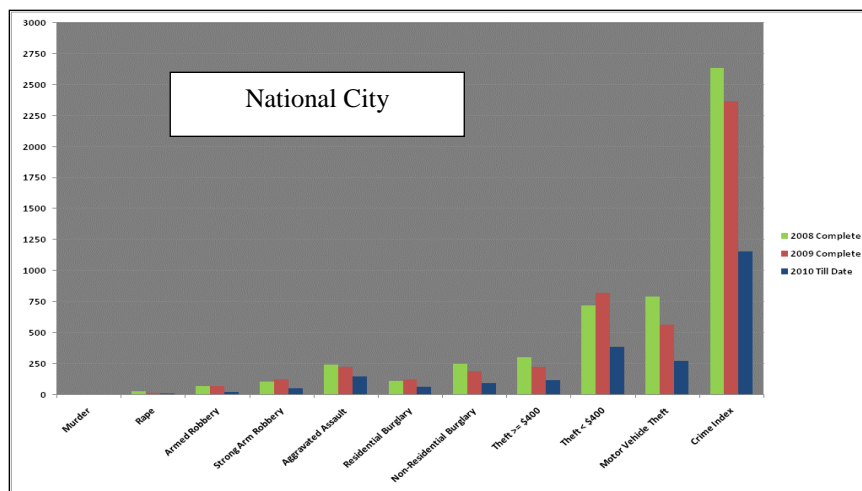


Figure 6.23. National City crime rate bar chart.

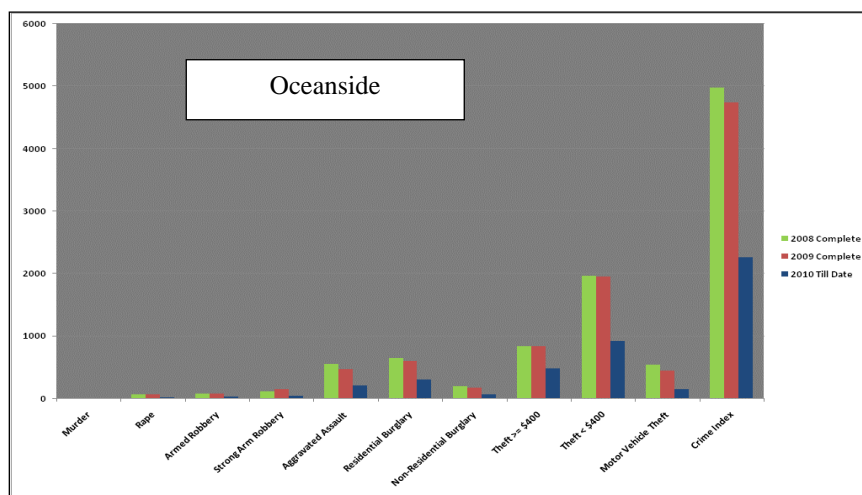


Figure 6.24. Oceanside crime rate bar chart.

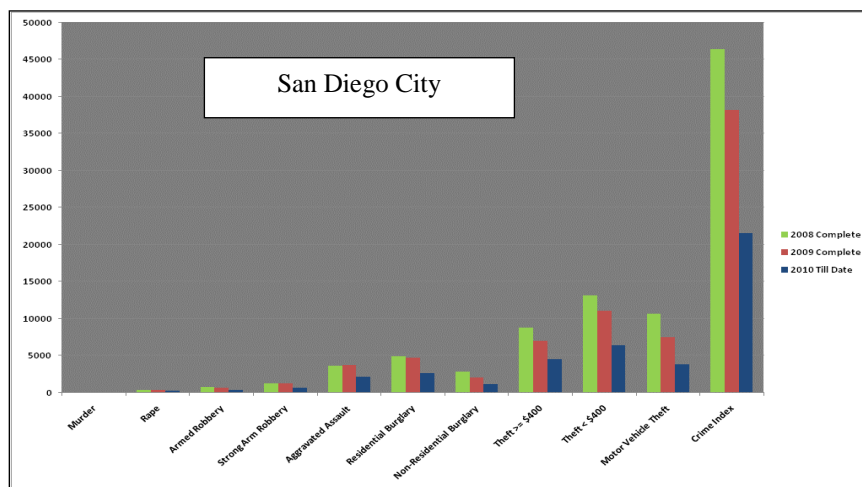


Figure 6.25. San Diego City crime rate bar chart.

CHAPTER 7

NETBEANS AND MAP OBJECTS

Application development has been done using NetBeans IDE, it is free to acquire from the internet and is also easy to use and configure add on libraries [14]. Map Objects libraries can be easily configured into the IDE [14]. Below are the steps followed to configure Map Objects libraries into the IDE:

1. Download and install NetBeans from the internet, it is free [16].
2. Acquire Map Objects Java Edition from Dr. Carl Eckberg and install it.
3. Start NetBeans IDE.
4. Start a new project from the file menu or hold Ctrl+Shift+N, as shown in Figure 7.1.
5. Choose the project category as “Java”. Figure 7.2 shows choosing project category dialog.
6. Click “Next” and then give a meaningful name for the project to be stored in the desired location. Figure 7.3 show the name and location dialog.
7. Click “Finish” to open the new project which has been created. Figure 7.4 shows the new project opened.
8. Right click on “Libraries” sub-node under JavaApplication4 node, as shown in Figure 7.5.
9. Click on “Add Library” and the add library dialog will show up as Figure 7.6.
10. Click on “Create” button, which will open “Create New Library” dialog. Type in a meaning name for the ESRI library in which all the Map Objects Libraries will be saved. Figure 7.7 shows create new library dialog.
11. Click “Ok” which will open “Customize Library” dialog, as shown in Figure 7.8.
12. Click on “Add Jar/Folder” button and browse to the “lib” folder within Map Object’s installation directory, as shown in Figure 7.9.
13. Click on “Add JAR/Folder” button and then “Ok” at “Customize Library” dialog to add this new library to the list of available libraries. Figure 7.10 shows the new library “ESRI_MapObjects_2.0.Y” under available libraries.

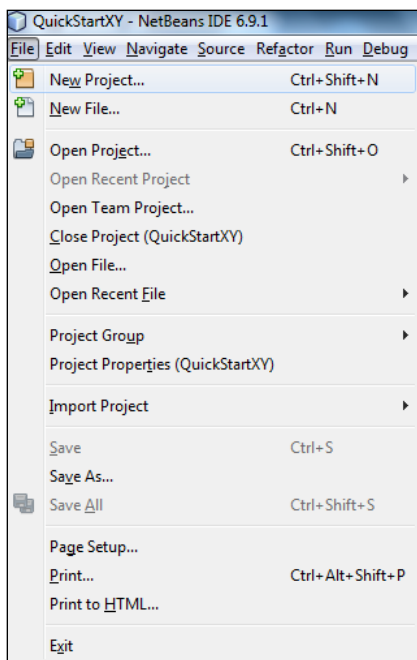


Figure 7.1. File menu in NetBeans IDE.

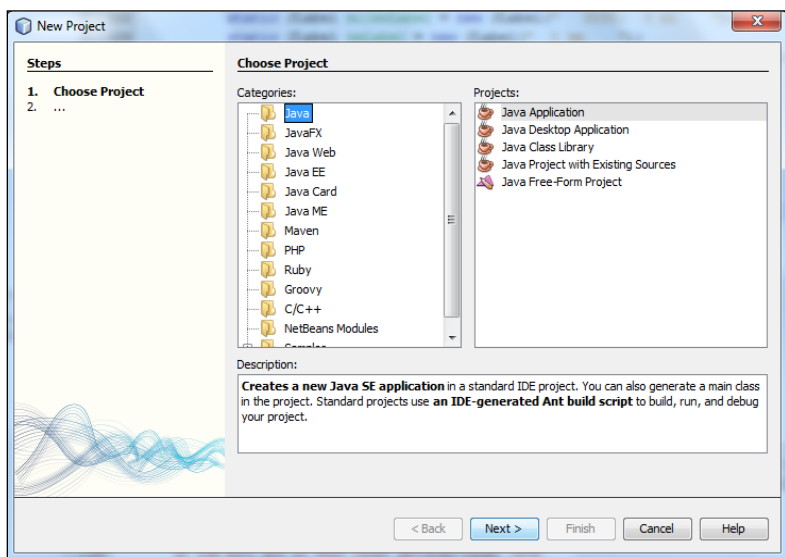


Figure 7.2. Choose project category dialog.

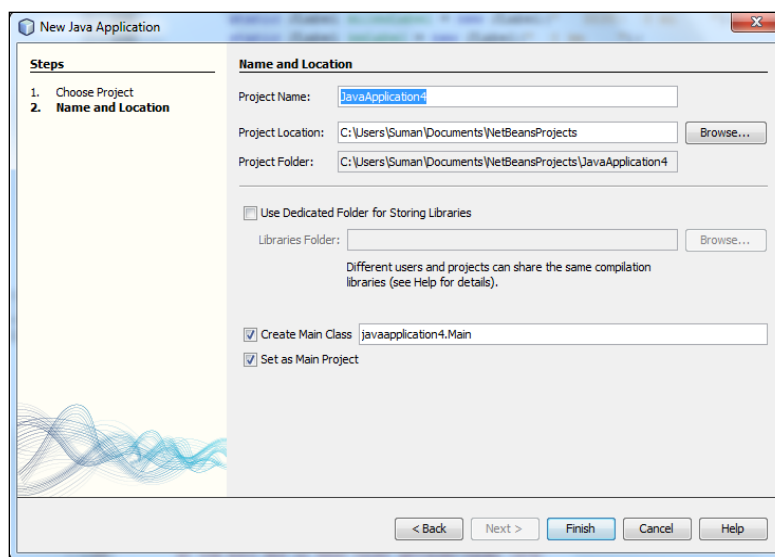


Figure 7.3. Project name and location dialog.

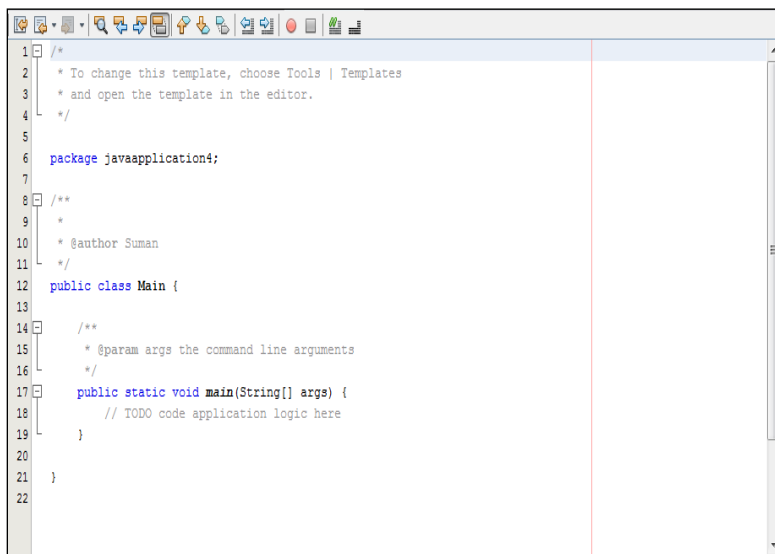


Figure 7.4. New project.

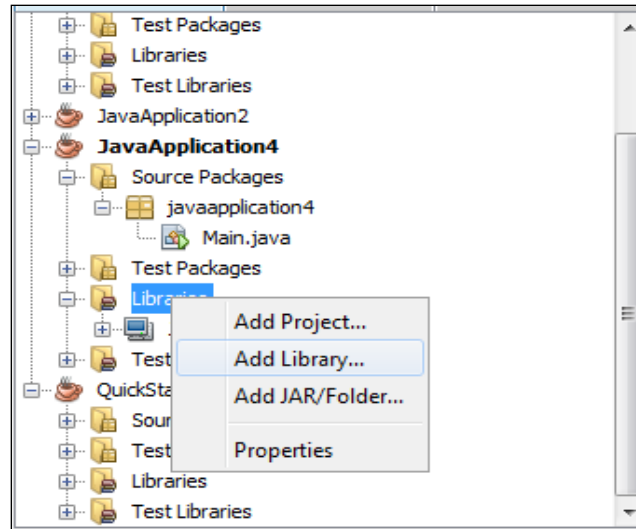


Figure 7.5. Dialog when right clicked on “Libraries”.

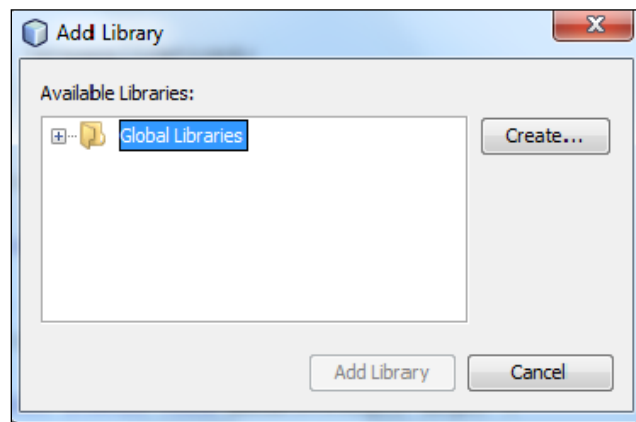


Figure 7.6. Add library dialog.

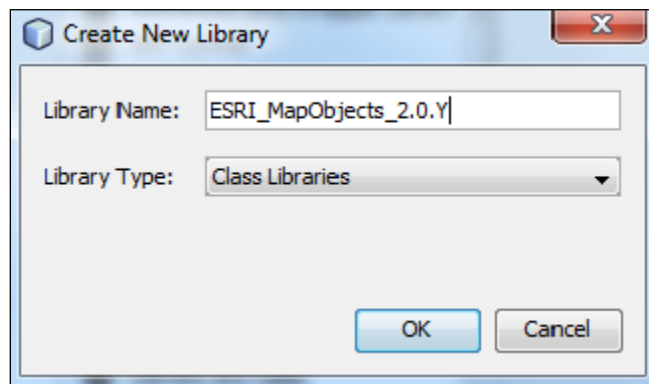


Figure 7.7. Create new library dialog.

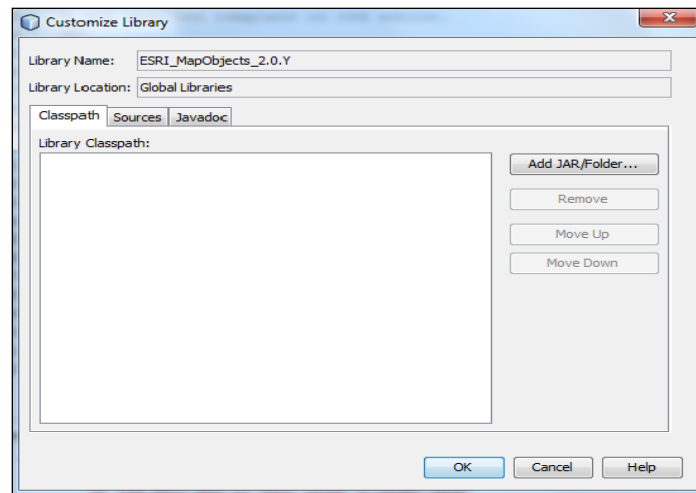


Figure 7.8. Customize library dialog.

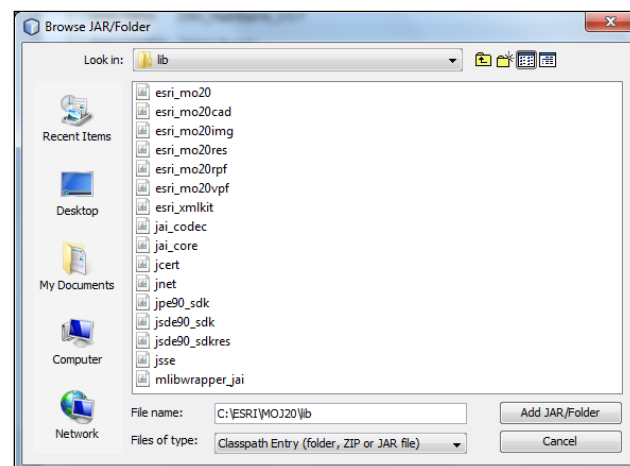


Figure 7.9. Showing the JAR files within “lib” folder.

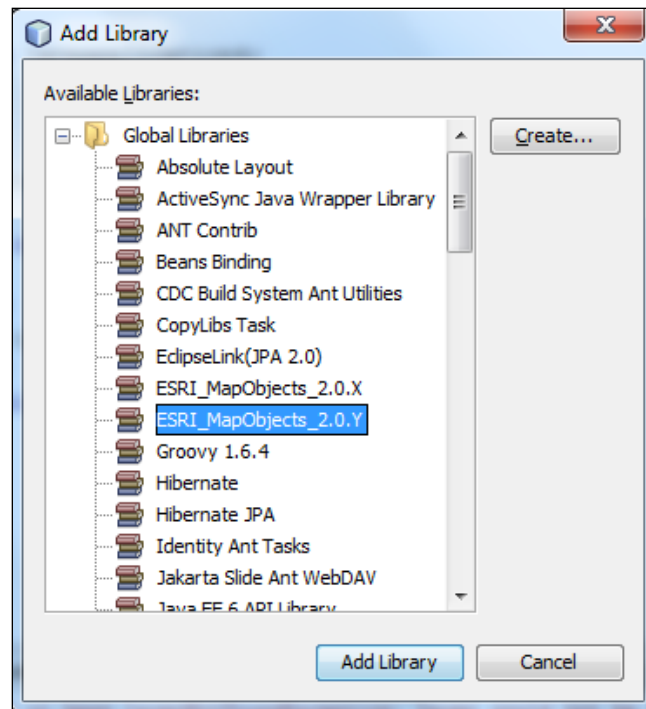


Figure 7.10. Showing the new library which has been added.

CHAPTER 8

APPLICATION DEVELOPMENT

Application was developed in various iterations, each time a prototype was created. After the prototype was created it was reviewed by Mr. Morris and further requirements were given, and he also gave some ideas.

The application can be divided into four parts:

1. Menu Bar.
2. Map Area.
3. Table of Contents (TOC).
4. Toolbar.

Menu bar and its contents have been discussed in Appendix C. We will concentrate more on the other parts.

8.1 MAP AREA

This is where you will see the base map and all other map layers if added, and this is where you can edit, select, analyze and view the results using different tools. The base map is added to a Java container called JPanel.

When you add a layer to the map, you are adding the shapefile which always has .shp extension. There are other files which support this shapefile; you can't see the map unless you have all these files. Below are the files types which you need to see a map:

- “.shp” → Stores the geometry of the features, which can be polygons, points or lines.
- “.shx” → Stores indexes of features for easy lookup and retrieval.
- “.dbf” → Stores all the data related to each shape in the form of columnar attributes.

Figure 8.1 displays the application, where you can see the continental United States map in the map area.

8.2 TABLE OF CONTENTS

Table of contents is the panel on the left side of map area and is like the real table of contents where you can see all the layers contained in the application. Figure 8.2 shows the table of contents with three layers; you can turn the layer on and off by selecting and

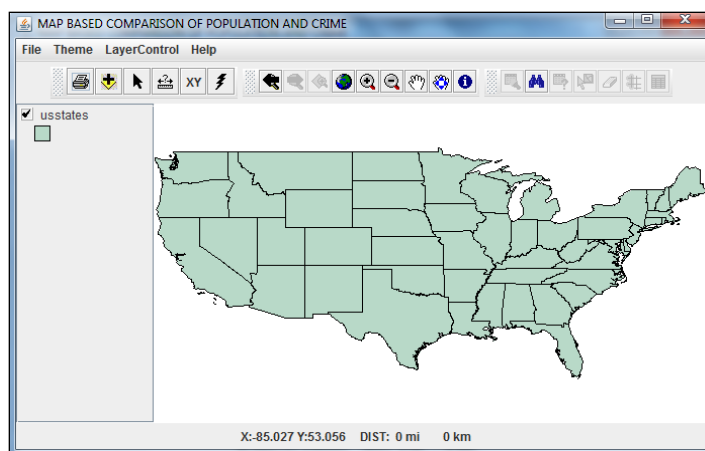


Figure 8.1. Tool showing the continental US map.



Figure 8.2. TOC showing three layers.

deselecting the checkbox beside the layer. The following code is used to add to add the table of contents to the container.

```
com.esri.mo2.ui.bean.Toc toc1 = new
com.esri.mo2.ui.bean.Toc();
toc1.setMap(map1);
add (toc1, java.awt.BorderLayout.WEST);
```

8.3 TOOLBAR

All the tools on the toolbar are covered in Appendix C, most of which are the general tools. But the following tools are customized tools and needs some discussion:

- Measure Tool.
- XY Tool.
- Hotlink Tool.

8.3.1 Measure Tool

This tool looks like a ruler with two arrows separated by a “?” symbol and is usually used to measure the distance from point A to point B. In this application say if we add a state capitals layer which is a point layer and if we want to want to measure the distance between two state capitals then we can use this tool to measure the distance. Figure 8.3 shows the icon of the tool and also the tool tip text assisting the users with the usage and the functionality.



Figure 8.3. Measure tool and the tooltip text.

The following code will calculate the distance based on the origin point x and y coordinates and destination x and y coordinates:

```
class DistanceTool extends DragTool {
    int startx, starty, endx, endy, currx, curry;
    com.esri.mo2.cs.geom.Point initPoint, endPoint,
    currPoint;
    double distance;
    public void mousePressed(MouseEvent me) {
        startx = me.getX(); starty = me.getY();
        initPoint = QuickStartXY.map.transformPixelToWorld
        (me.getX(), me.getY());
```

```

    }
    public void mouseReleased(MouseEvent me) {
        // now we create an acetatelaye instance and draw a
        line on it
        endx = me.getX(); endy = me.getY();
        endPoint = QuickStartXY.map.transformPixelToWorld
        (me.getX(),me.getY());
        distance = (69.44 / (2*Math.PI)) * 360 * Math.acos(
            Math.sin(initPoint.y * 2 * Math.PI / 360)
            * Math.sin(endPoint.y * 2 * Math.PI / 360)
            + Math.cos(initPoint.y * 2 * Math.PI /
            360)
            * Math.cos(endPoint.y * 2 * Math.PI / 360)
            * (Math.abs(initPoint.x - endPoint.x) <
            180 ?
                Math.cos((initPoint.x -
                endPoint.x)*2*Math.PI/360):
                Math.cos((360 -
                Math.abs(initPoint.x -
                endPoint.x))*2*Math.PI/360)));
        System.out.println( distance );
        QuickStartXY.milesLabel.setText("DIST: " + new
Float((float)distance).toString()+ " mi ");
        QuickStartXY.kmLabel.setText(new
Float((float)(distance*1.6093)).toString() + "km");
        if (QuickStartXY.acetLayer != null)
            QuickStartXY.map.remove(QuickStartXY.acet
            Layer);
        QuickStartXY.acetLayer = new AcetateLayer() {
            public void paintComponent(java.awt.Graphics g)
            {
                java.awt.Graphics2D g2d =
                (java.awt.Graphics2D) g;
                Line2D.Double line = new
Line2D.Double(startx,starty,endx,endy);
                g2d.setColor(new Color(0,0,250));
                g2d.draw(line);
            }
        };
        Graphics g = super.getGraphics();
        QuickStartXY.map.add(QuickStartXY.acetLayer);
        QuickStartXY.map.redraw();
    }
    Public void cancel() {};
}

```

8.3.2 XY Tool

This tool will let you add the CSV files to the application; these CSV files will have the latitude and longitude values which represent certain points on the globe. Figure 8.4 shows the dialog which opens when you click on the “XY” tool.

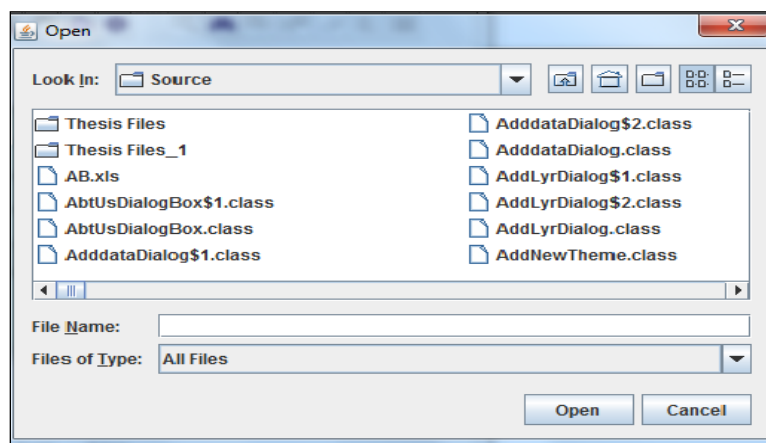


Figure 8.4. Open file dialog.

The following lines will let you open the dialog to choose the file:

```
File dirInit = new
File("c:\\esri\\MOJ20\\Suman\\Source");
JFileChooser jfc = new JFileChooser();
jfc.setCurrentDirectory(dirInit); //initial folder
jfc.showOpenDialog(this);
File file = jfc.getSelectedFile();
```

The next two lines will read the file:

```
FileReader fred = new FileReader(file);
BufferedReader in = new BufferedReader(fred);
```

And after reading the file, each line is broken down into tokens and these tokens are stored into variables. The following lines show adding the point after they have been stored into variable x and y:


```
StringTokenizer st = new StringTokenizer(s, ",");
str = st.nextToken();
System.out.println("1:"+str);
x = Double.parseDouble(str);
str = st.nextToken();
System.out.println("2:"+str);
y = Double.parseDouble(str);
xpoint.addElement(new Double(x));
ypoint.addElement(new Double(y));
```

```
bpa.insertPoint(n++, new com.esri.mo2.cs.geom.Point(x, y));
```

Color, shape and size of the points which will be added as a layer to the map are set using the following three lines. Using the following lines we can get yellow circular points with a width of 15.

```
sms.setType(SimpleMarkerSymbol.CIRCLE_MARKER);
sms.setSymbolColor(new Color(255,255,0));
sms.setWidth(15);
```

8.3.3 Hotlink Tool

When the user clicks on this tool, the cursor will change to a bolt symbol like . The basic idea behind this tool is to open up a picture or a file associated with a point, provided a hotlink has already been defined for that point.

In this application when you add the CSV file with the major cities of the United States, it gets converted into the point layer and will be added on top of the base map. When you click on the hotlink tool, the cursor will change to a bolt symbol indicating that the hotlink tool is active and so you can click on the cities. Hotlinks have been defined for these cities already, so when you click on a city, that city's population graph will pop up. Figure 8.5 shows the population graph for San Diego which pops up when one clicks on San Diego on the map.

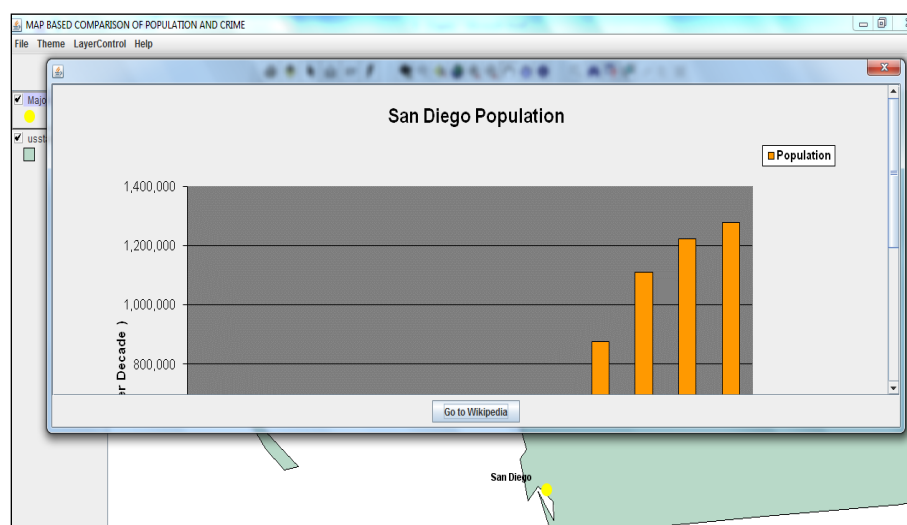


Figure 8.5. San Diego's population chart pop-up.

You cannot always see the hotlink image as the point where you click matters a lot. The following lines were used in the tool to determine whether the point clicked is close

enough to the actual point or not. The graph will pop up if the point is close enough to the actual point, if not you will not see anything.

```
if((point.x <= ( x + 0.05) && point.x >= (x -0.05)) &&
(point.y >= (y -0.05) && point.y <= (y + 0.05)))
{
    System.out.println(addXYtheme.s5.get(i));
    Image image =
    Toolkit.getDefaultToolkit().getImage((String)
    addXYtheme.s5.get(i));
    HotImage hotimage = new HotImage(image);
    hotimage.setVisible(true);
}
```

On the pop-up dialog you can see a button labeled as “Go to Wikipedia”, when clicked you will be taken to the city’s Wikipedia webpage.

CHAPTER 9

CONCLUSION

This thesis is a teaching aid for Mr. Morris, Department of Social Studies, Helix Charter High School. Dr. Carl Eckberg, Department of Computer Science, San Diego State University has been a great help and has played an important role along with Mr. Morris in shaping the project.

1. Customer Requirements: Customer is the king and the project has to be developed according to the customer requirements; there is no point in developing if the project doesn't meet the requirements.
2. Gathering Requirements: All the requirements were not gathered in just one sitting. Initially some requirements were given and when the development was done based on those requirements, new set of requirements were given after review by Mr. Morris based on the development process. The same routine continued until he was finally satisfied with the project.
3. Schedules: Our schedules never matched as I was working and also going to the school at the time. Had to take some time off on some occasions to meet and show the project progress.
4. Technical Challenges: Application development took a fairly good amount of time; requirements were just given out, which were then converted into technical terminology. Following are some of the technical challenges faced during phases of development:
 - a. New Environment: As the project is meant to be used in the school, it has to be fairly easy for Mr. Morris to use and also should be portable and platform independent so that he can take it anywhere and can run it on any machine. NetBeans was used, which was completely new at the beginning. Configuring Map Objects in NetBeans has been explained in Chapter 6 of this document.
 - b. Points on the map: When the user adds the CSV file with latitude and longitude values, the project will convert the file and then add the points to the map. In order to work with "Hotlink" you have to click almost as accurately as you can on the point, for which you might have to zoom-in few levels. Mr. Morris wanted me to change that feature as students would get frustrated doing so every single time. But if the feature is changed then the point upon which "Hotlink" clicks might not be the point which actually it is. So, we spoke about it and later decided to keep the feature as is.
5. Data Preparation and Collection: Lots of time was spent on data preparation and data collection. Base map was customized to take away Alaska and Hawaii to just show

the continental states. Latitude and longitude values were collected for all the cities being considered within the project. Population and crime data for the cities in consideration was collected from the internet and then was put together to create bar graphs which were then converted into GIF image files.

The thesis made me learn new software and work in new environments. I got a chance to get my hands on useful software: ArcGIS Desktop and one of the best environments, NetBeans. Last but not least I got a chance to explore Map Objects to a good extent.

Working with a real time customer Mr. Morris, was fun and also was a good learning experience and Dr. Carl Eckberg's guidance was very useful as well.

CHAPTER 10

FUTURE ENHANCEMENTS

Most of the requirements were given by Mr. Morris, Helix Charter High School, as this thesis has been developed for him to assist in his teaching with his geography and history classes. Most of the requirements have been listed under “Requirements” section of this document but again there can be some future enhancements done, like:

1. Much more GIS functionality can be added by adding various toolbars.
2. Privilege can be given to the user to add on the fly hotlinks by adding latitude and longitude values right from the tool without needing to add another CSV file.
3. More buttons can be added to the dialog to show more details about the city rather than just the city’s “Wikipedia” page.
4. Quizzes can be included within for testing on the skills learnt.
5. Can be extended to topics like economy, revenue, traffic and so on.
6. Customized reports can be created from the analyzed data.
7. If possible crime data, from all the years for which population is given, could be gathered to better correlate crime data with population data.

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APPENDIX A

LIST OF ACRONYMS

The acronyms below have been used throughout the thesis:

IDE → Integrated Development Environment

GIS → Geographic Information Systems

ESRI → Environmental Systems Research Institute

PDF → Portable Document Format

JDK → Java Development Kit

JAR → Java Archive

GIF → Graphics Interchange Format

CSV → Comma Separated Values

SANDAG → San Diego Association of Governments

ARJIS → Automated Regional Justice Information System

SDPD → San Diego Police Department

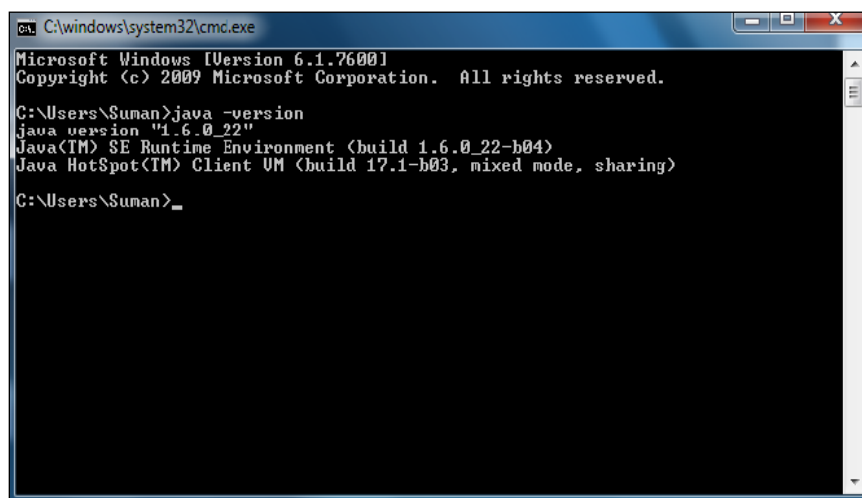
APPENDIX B

USER MANUAL: PREREQUISITES CHECK

Java 1.4 or higher version should already have been installed on the machine. If Java is not installed, it should be installed. Follow below steps to check the version of Java, if it is already installed.

B.1 WINDOWS MACHINES

1. Open command prompt (cmd) on the machine from start menu.
2. Write “Java –version” at the prompt, as shown in Figure B.1 and hit “Enter” key on the keyboard.
3. Now you can see the version of Java as “1.x.x_xx”, if it’s installed. It is 1.6.0_22 in the Figure B.1.
4. If Java is not already installed you will get a command line message saying unknown command. Java can be downloaded for free from the link following:
<http://www.java.com/en/download/manual.jsp>.



```
C:\windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7600]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\Suman>java -version
java version "1.6.0_22"
Java(TM) SE Runtime Environment (build 1.6.0_22-b04)
Java HotSpot(TM) Client VM (build 17.1-b03, mixed mode, sharing)

C:\Users\Suman>
```

Figure B.1. Checking Java version at command prompt.

B.2 MACINTOSH MACHINES

Java is pre-installed on machines which run on Mac OS X operating system, to check the version of Java follow below steps:

1. Open “Terminal” from Application Utilities.
2. Write “java –version” at the prompt and hit “Enter” key on the keyboard.
3. Now, you should see the version installed on the machine.

APPENDIX C

USER MANUAL: KNOWING THE TOOL

Below are the steps to get hands on and work around with the tool:

1. Get the installation CD.
2. Copy all the folders on to local hard drive.
3. Browse to “QuickStartXY.jar” file which is within the “dist” folder.
4. Double click the “QuickStartXY.jar” file to start the tool. As shown in Figure C.1.
5. Now that the tool is up and running, we should get to more about the tool.
6. The tool has 4 parts:
 - a. Menu Bar.
 - b. Toolbar .
 - c. Table of Contents (TOC).
 - d. Map.
- 6.1 Menu Bar: Menu bar the following items:
 - 6.1.1 File: File menu has following items under it, as shown in Figure C.2.
 - a. Add Layer: Will let you add new layers. Figure C.3 shows the add layer dialog.
 - b. Print: Will let you print the map. Figure C.4 shows the print dialog.
 - c. Remove Layer: Will let you remove the selected layer.
 - d. Legend Editor: Will let you edit the selected layer. You can set the labels, change the font and size of the labels, add effects to them, change the position of labels, etc. Figure C.5 shows the legend editor dialog.
 - 6.1.2 Theme: Theme menu has following items under it, as shown in Figure C.6.
 - a. Open Attribute Table: Will show you the attributes for the selected layer. Figure C.7 shows the attribute table screenshot for States in the United States of America.
 - b. Create Layer From Selection: Will let you create a separate layer from the selection made on the map.
 - 6.1.3 LayerControl: LayerControl menu has the following items under it, as shown in Figure C.8.
 - a. Promote Selected Layer: Will promote the selected layer one level up.
 - b. Demote Selected Layer: Will demote the selected layer one level down.
 - 6.1.4 Help: Help menu has only view help under it, as shown in Figure C.9.

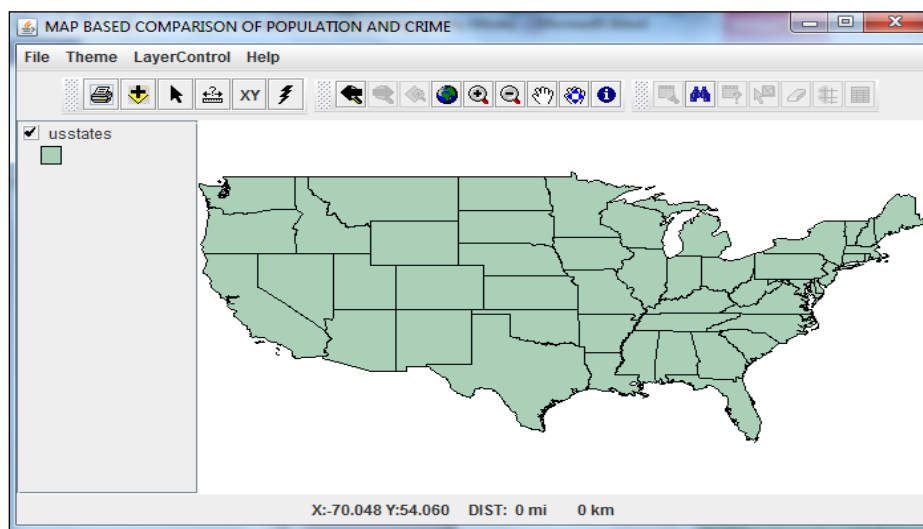


Figure C.1. Tool when it is opened initially.

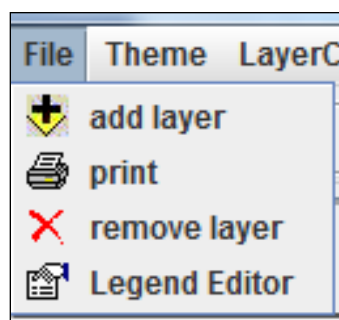


Figure C.2. File menu.

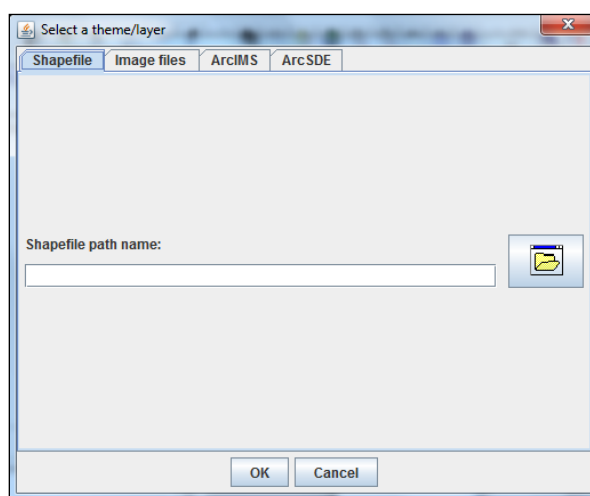


Figure C.3. Add layer dialog.

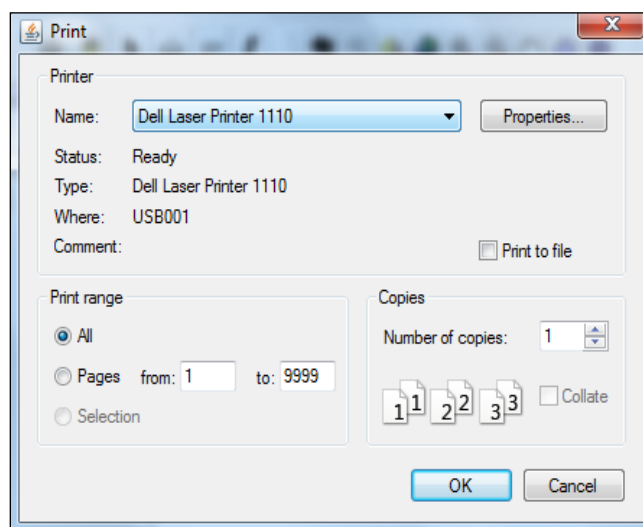


Figure C.4. Print dialog.

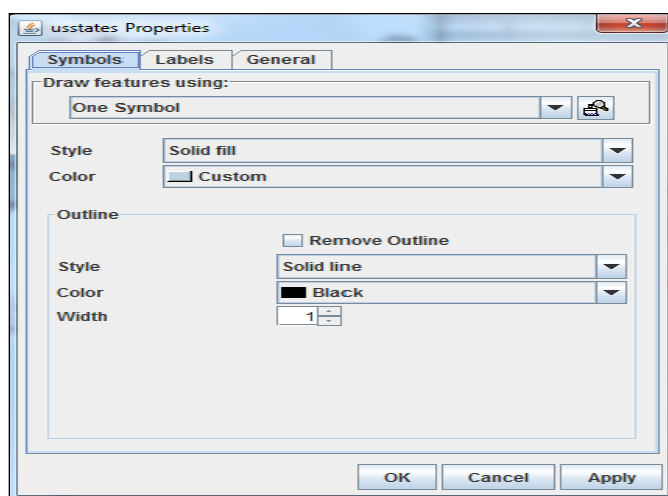


Figure C.5. Legend editor dialog.

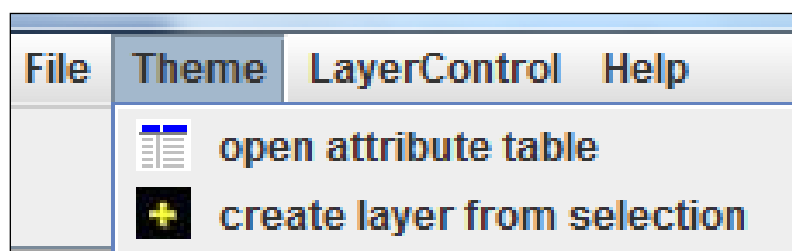
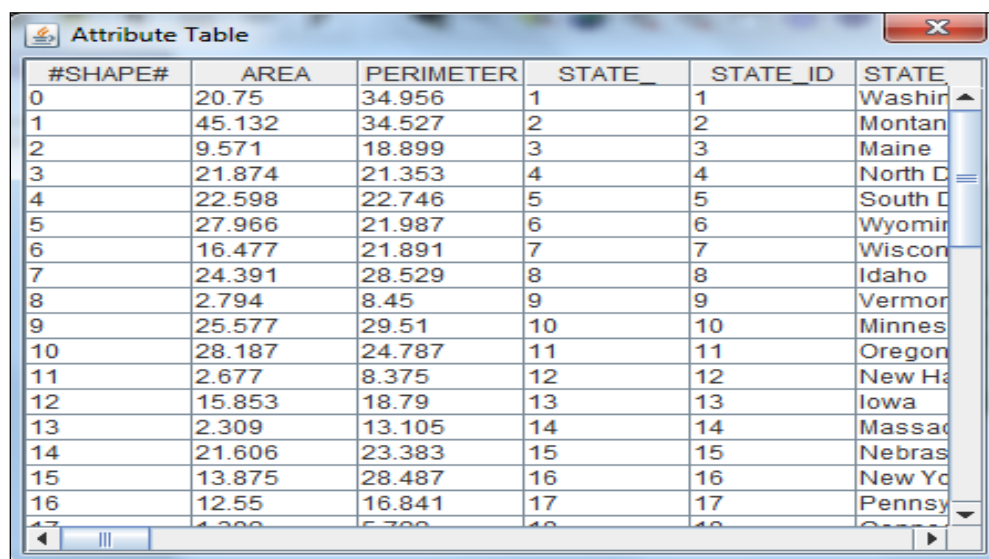


Figure C.6. Theme menu.



#SHAPE#	AREA	PERIMETER	STATE_	STATE_ID	STATE
0	20.75	34.956	1	1	Washin
1	45.132	34.527	2	2	Montan
2	9.571	18.899	3	3	Maine
3	21.874	21.353	4	4	North D
4	22.598	22.746	5	5	South D
5	27.966	21.987	6	6	Wyomir
6	16.477	21.891	7	7	Wiscon
7	24.391	28.529	8	8	Idaho
8	2.794	8.45	9	9	Vermor
9	25.577	29.51	10	10	Minnes
10	28.187	24.787	11	11	Oregon
11	2.677	8.375	12	12	New Ha
12	15.853	18.79	13	13	Iowa
13	2.309	13.105	14	14	Massac
14	21.606	23.383	15	15	Nebras
15	13.875	28.487	16	16	New Yo
16	12.55	16.841	17	17	Pennsy
17	4.288	5.788	18	18	Conn

Figure C.7. Attribute table.

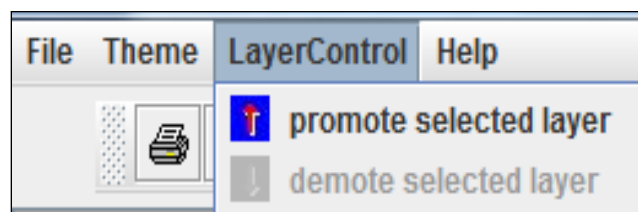


Figure C.8. LayerControl menu.

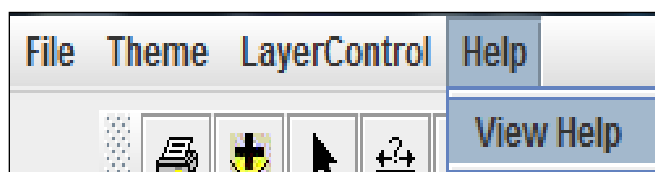


Figure C.9. Help menu.

- a. View Help: Has the help instructions about using the tools in the toolbar. Figure C.10 shows the screenshot of the view help.
- 6.2 Toolbar: Toolbar has the following items, as shown in Figure C.11.
 - 6.2.1 Print: Will let you print the map. Figure C.12 shows the print dialog.
 - 6.2.2 Add Layer: Will let you add new layers. Figure C.13 shows the add layer dialog.
 - 6.2.3 Pointer: Will change the cursor to pointer if the cursor is something else.
 - 6.2.4 Measure: Will let you measure the distance from point A to point B. You can see the distance in “Miles” and also “Kilometers” below the map.
 - 6.2.5 XY: Will let you add CSV files as long as they are in the right format. These CSV files will be converted into point layers. Figure C.14 shows the dialog for adding files.
 - 6.2.6 Hotlink: Will change the cursor to “bolt”. When clicked on a hotlink will open a picture.
 - 6.2.7 Previous Extent: Will take you to the previous extent from the current extent, it’s just like the undo button.
 - 6.2.8 Next Extent: It’s just like the redo button, will take you to the next extent.
 - 6.2.9 Zoom to Active layer: When clicked it will zoom to the active layer when the layer is active on the TOC and if you can’t see it.
 - 6.2.10 Zoom to Full Extent: If you zoom into a particular area and then want to go back and see the whole map, click on this.
 - 6.2.11 Zoom In: Will let you zoom in.
 - 6.2.12 Zoom Out: Will let you zoom out.
 - 6.2.13 Pan: Will let you move all over the map.
 - 6.2.14 Pan One Direction: Will let you move in one direction, either North or South or East or West.
 - 6.2.15 Identify: Will show you the details about particular part of the map, when clicked on that part. Figure C.15 shows the identify results for North Dakota state.
 - 6.2.16 Search: Will let you search within the map.
 - 6.2.17 Find: Will let you find a value within a layer. Figure C.16 shows the find dialog.
 - 6.2.18 Query Builder: Will let you perform various ad-hoc queries on the fields within the layers. Figure C.17 shows the query builder.

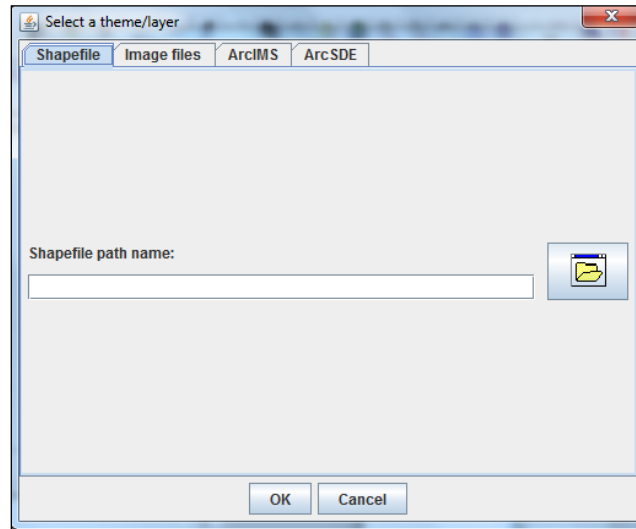


Figure C.13. Add layer dialog from the toolbar.

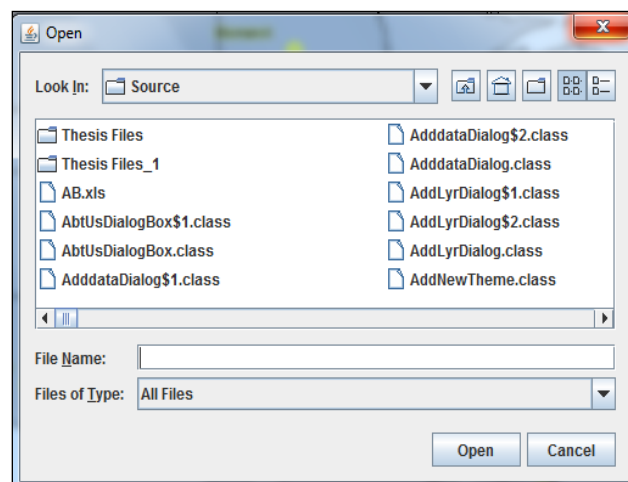


Figure C.14. Dialog for adding files.

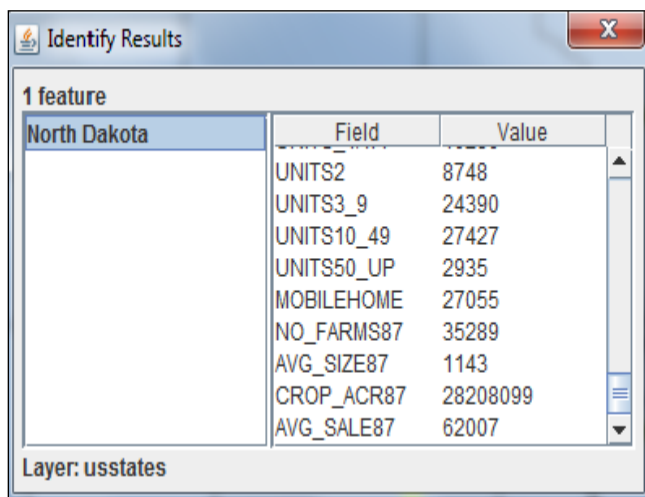


Figure C.15. Identify results dialog.

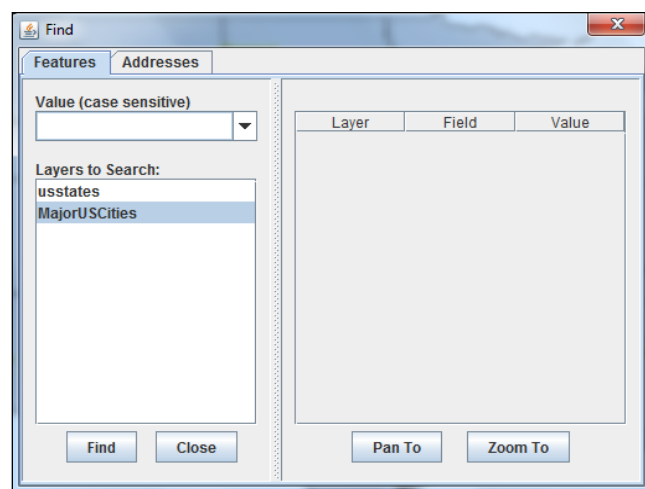


Figure C.16. Find dialog.

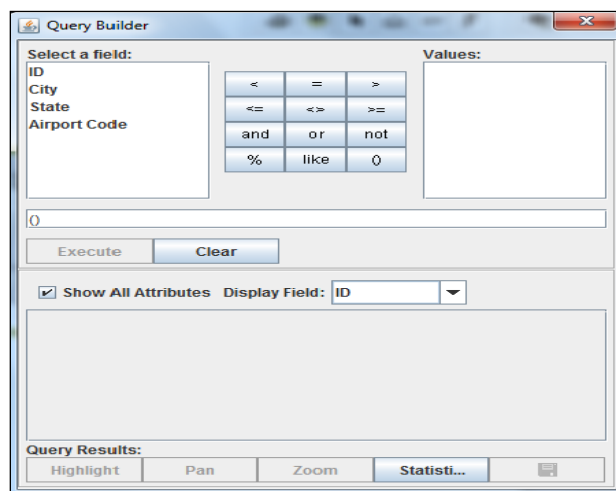


Figure C.17. Query builder dialog.

- 6.2.19 **Select Features:** Will let you select parts of the map or the entire map using rectangle or circle or line or polygon features.
- 6.2.20 **Clear All Selection:** Suppose you have used the rectangle feature to select some part of the map, by clicking this you can clear all the selection.
- 6.2.21 **Buffer:** Will let you create a buffer around the selection so that you can do further analysis. Figure C.18 shows the buffer dialog.
- 6.2.22 **Attributes:** Will show you the attributes for the selection on the map. Figure C.19 shows the attributes for the city Bismarck.
- 6.3 **Table of Contents (TOC):** Table of contents is the one that holds all the map layers. A particular layer can be turned on and off by selecting and deselecting the checkbox beside the layer name on the TOC. Figure C.20 shows the TOC with three layers.
- 6.4 **Map:** Map is the area where we can see all the layers which are added to the TOC. Figure C.21 shows the map with the continental United States and the major cities in the United States.

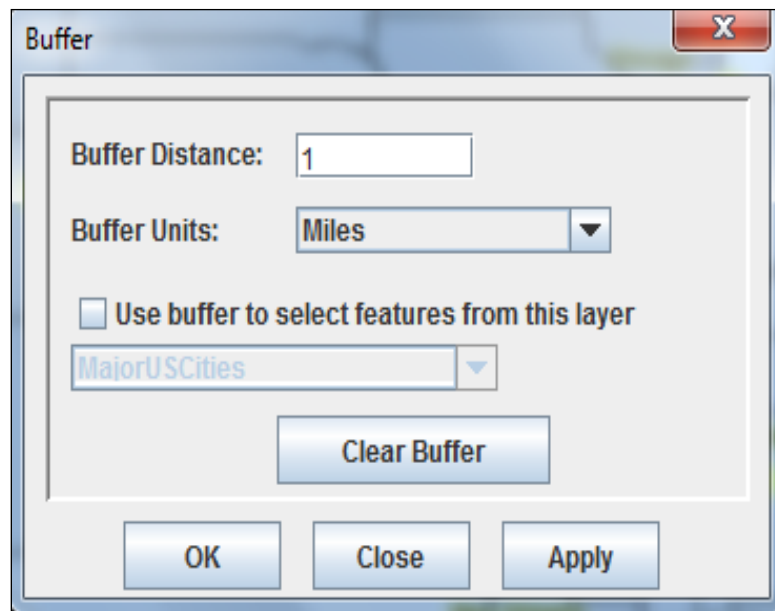


Figure C.18. Buffer dialog.

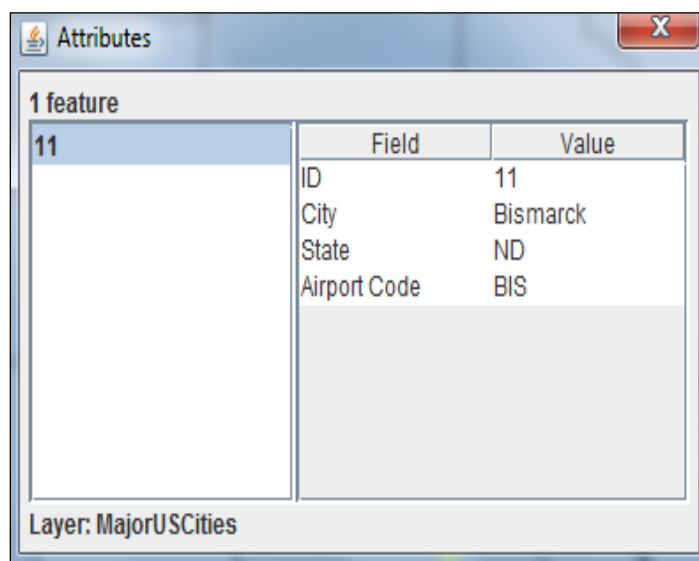


Figure C.19. Attributes dialog.

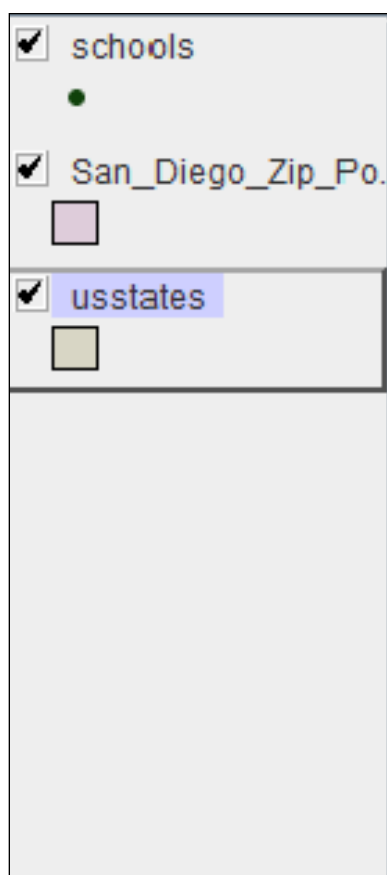


Figure C.20. TOC.

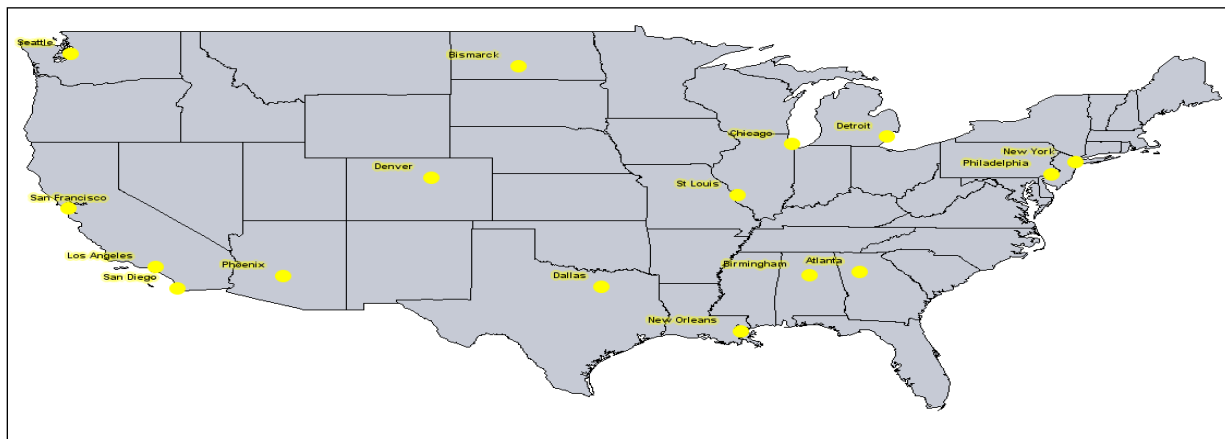


Figure C.21. Map with two layers.